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Unusual Features in Factory Plant

KIMBERLY-CLARK CO.'S PLANT AT KIMBERLY, WIS., HAS NOVEL ASH-HANDLING SYSTEM AND OPERATES STEAM AND WATER TURBINES IN PARALLEL

ALONG THE BANKS of the Fox River in eastern Wisconsin, are located many paper and pulp mills. The location is advantageous owing to the nearness to forests which yield wood necessary for paper making, the great supply of water at hand and the fall of the river which affords a wonderful amount of power.

Among the foremost and most important of these paper plants is that of the Kimberly-Clark Co., at Kimberly. Here we find a complete plant turning out book paper from logs delivered to the plant either by water or rail. The process is that common to most paper mills, but several features in the power plant equipment and operation are unusual and intensely interesting.

Originally the power was furnished entirely by water wheels, 29 of which are now in operation working under a head of 9½ ft. average, and developing 75 hp. each, driving the mill direct through line shafts and bevel

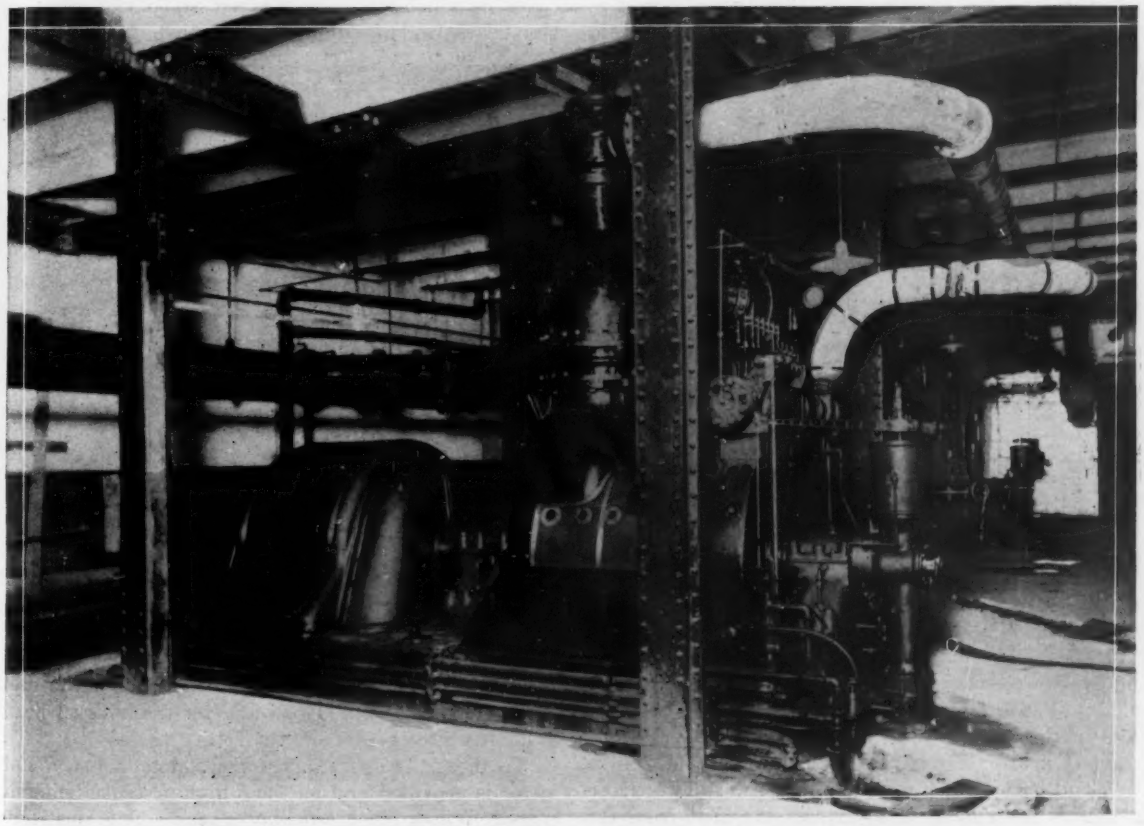


FIG. 2. VIEW IN GENERATING ROOM SHOWING THE 750 AND 1000 KV.A. UNITS

gears. Later boilers and engines were added, generators connected to water wheels, Diesel engines driving direct-connected generators were tried out, power transmitted from the Appleton plant of the company which developed more power than requirements demanded, and the last move is the installation of steam turbines which work in synchronism with the waterwheel generators to

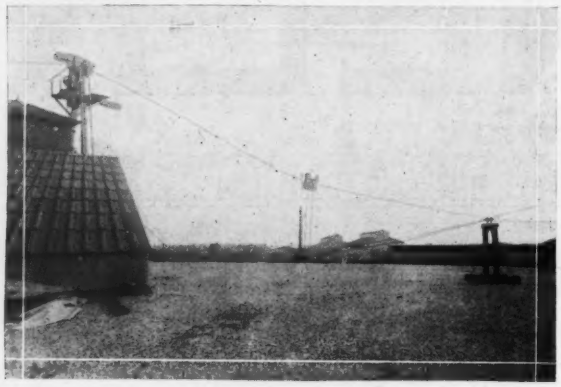


FIG. 1. CABLE SYSTEM FOR CONVEYING ASHES

supply all the needs of the Kimberly plant. The mill has not been completely electrified, but will be, as changes in equipment seem desirable.

In the Boiler Room

Steam is furnished to the turbines and paper machine engines by 8 300-hp. B. & W. boilers. Three of these operate at 200 lb. pressure and superheat the steam 150 deg. for use in the turbines. The other 5 boilers work under a pressure of 120 lb., and furnish steam for the paper machine engines and auxiliaries. A reducing valve is placed between the high and low-pressure headers to allow the use of steam from the high-pressure boilers in the low-pressure system.

Boilers are of standard construction, placed 2 in a setting and baffled for 3 passes of the gases. Two Green economizers are employed to extract the heat from the flue gases on their way to the stack which is 175 ft. high.

Murphy automatic dutch oven furnaces serve the boilers and are operated by stoker engines, 1 engine running 2 stokers.

Coal is brought to the plant in cars which discharge to the hopper of a scraper conveyor. This delivers to a coal crusher which in turn discharges to the buckets of a conveying system to be elevated and stored in a steel bunker extending the entire length of the boiler room. Chutes lead from the bunker to the stoker hoppers, making the entire coal-handling system automatic.

The motors used consist of a 3-hp. on the scraper conveyor, a 15-hp. on the crusher and a 10-hp. on the bucket conveyor placed at the head of the drop.

Ashes are scraped from the ash pits into the same bucket conveyor and delivered into a hopper at the end of the boiler room. They discharge from the hopper to a bucket which is hoisted to a cable and carried considerable distance over the roofs of buildings to an ash dump on the hill.

Feed water is taken from the river and treated in a Kennicott water softener before being fed to the boilers. For feeding the high pressure boilers, 1 American simplex packed plunger pump is used with a triplex motor-driven American pump as a standby. The feed pump for the low-pressure boilers consist of 1 Dean simplex, 1 Fairbanks-Morse duplex and 1 motor-driven Goulds triplex pump as a reserve.

These pumps exhaust into a return tank which is open to atmosphere and receives all the condensate from the paper machines. This tank is left uncovered and the space above it is fitted with a platform upon which boxes in which paper is shipped are placed until they become thoroughly dry, so that the paper will not be damaged by moisture in the boards. Feed water is taken from this return tank and pumped through the economizers to the boilers. Hot water for the indirect heating system is also taken from the return tank.

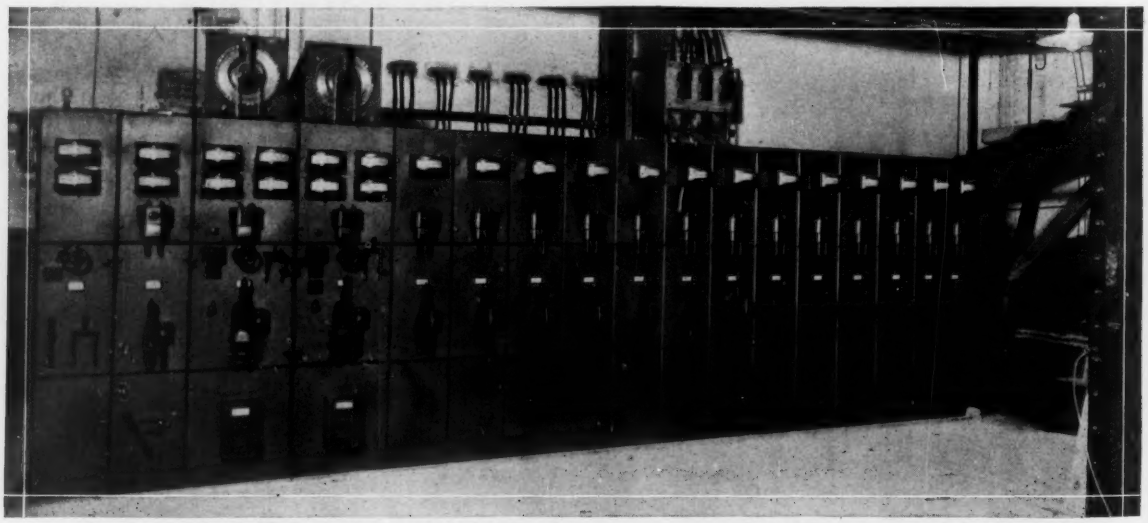


FIG. 3. FRONT VIEW OF SWITCHBOARD TO WHICH A PANEL WILL BE ADDED TO CARE FOR THE NEW TURBINE UNIT

To check the operation of the boilers, a Lea V-notch meter is provided and on the 3 high-pressure boilers are placed Wilsey fuel economy gages. This instrument

measures the difference in temperature between the furnace and flue gas, working on the principle of the Wheatstone bridge with a resistance coil in the furnace and another in the uptake, the measuring element being a millivolt-meter.

The regular load on these 3 boilers is the 2 turbines which generate 1750 kw., so it will be noted that they are run greatly above rating, although the economizers help to increase their capacity.

Generating Machinery

The turbine equipment consists of 1 1000-kv.a. horizontal Curtis turbine unit and 1 750-kv.a. unit, both run at 1500 r.p.m. and generate 3-phase alternating current at 25 cycles and 480 v. Each turbine is served by a No. 8 Westinghouse Leblanc condenser placed on the same floor as the turbine. This location was necessary on account of the floor being too near the river level to permit a basement. Condensing water is taken from the Fox River through a pipe, the intake to which is provided with a screen to prevent trash from getting to the condensers. The vacuum carried varies somewhat, depending upon the temperature of the condensing water, but averages 28 in.

Air for cooling the generators is brought in from outdoors through separate galvanized iron ducts and discharged through others, so that the temperature of the room is quite independent of the generators.

For each unit, one gage board is provided, which is equipped with instruments to show steam pressure, pressure in first stage, vacuum and speed.

A new turbine has just been installed, which has a capacity of 1500 kv.a. and runs at 400 r.p.m., being geared to the generator which has a speed of 500 r.p.m. This is also a Curtis turbine and General Electric Co. generator, developing 3-phase current at 480 v., 25 cycles; the condenser, however, is of the Wheeler surface type.

Current is supplied to cranes by 2 motor-generator sets, which may be run in parallel and consist of induction motors connected to d.c. generators, one developing 25 kw., at 440 v., the other 35 kw., each set has a separate switch panel.

FIG. 5. GENERATOR RUN AS SYNCHRONOUS CONDENSER

The exciter set is a motor-generator consisting of a 50-hp. induction motor run at 750 r.p.m., connected to a 35-kw. d.c. generator delivering current at 125 v.

One of the distinctive features of this plant is the main switchboard, which consists of 18 panels; 2 of these are equipped with instruments and switches for the exciter set, 1 supports the Tirrill regulator, 3 have

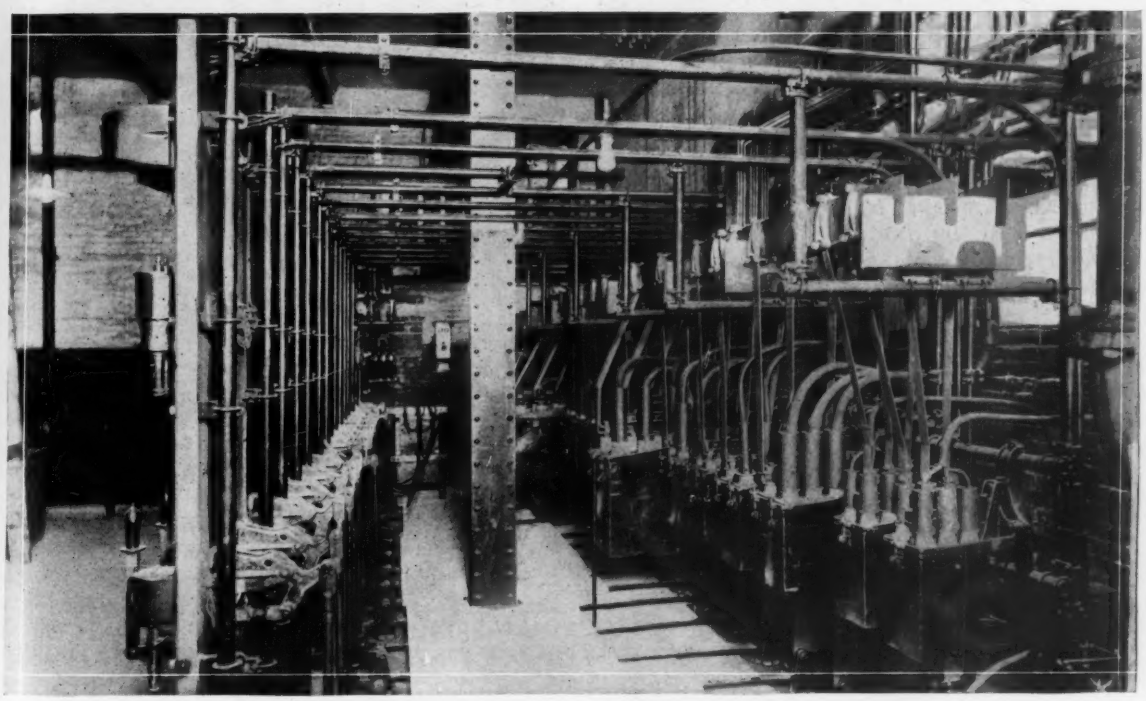


FIG. 4. LOOKING DOWN THE PASSAGEWAY BETWEEN PANELS AND SWITCHES

the main switches and instruments for the generators, and the rest are service panels.

All the circuit breakers are operated through rods and bell cranks, which arrangement provides for a passageway between the panels and main switches. The distinctive feature of the board is an automatic cut-out arrangement, which was made necessary in order to operate the turbine plant in parallel with the hydraulic plants.

Under usual conditions, the water wheels in both plants are run with a wide open gate, thus developing the full power available. The steam turbines operate in synchronism with the hydraulic units, but follow them; i.e., the voltage is just enough lower than the hydraulic generators that the steam turbines take all the variation in load, while the hydraulic generators operate constantly, at their full load. The water wheels, however, are provided with Lombard governors which come into play when the load on the plant decreases considerably.

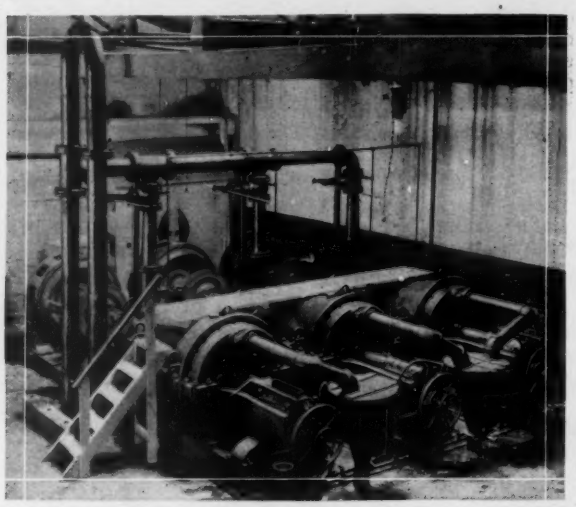


FIG. 6. APPLICATION OF SYNCHRONOUS MOTORS TO JORDAN ENGINES GRINDING PULP

In the Kimberly mills are a number of paper machines and a bleaching plant that can be stopped only at a considerable loss in time and money, while other parts of the plant may be shut down for a short time without serious loss. Under the ordinary method of operation, if an accident should occur to the transmission line from Appleton to Kimberly, shutting off that source of power without warning, with only one steam turbine in operation, the load thrown upon it by the accident would be sufficient to trip the breaker and shut down the whole plant until the other turbine could be put into operation.

To overcome this possibility, a relay is placed on each generator panel which operates when the current reaches a certain maximum lower than the tripping current of the main breaker; this, in turn, closes a relay on the back of the board, throwing current through the tripping coils of the service breakers which may be opened without serious loss to the plant, leaving those switches closed which feed the machines that must be kept in constant operation. When this occurs, only part of the plant need be shut down for a few minutes, as another turbine put into operation will supply all necessary power to the plant.

At Appleton the generating capacity of the plant is 750 kv.a., the head on the turbines being 14 ft. A large share of this power is transmitted to Kimberly at a voltage of 6600, the distance being 5 mi. A single 3-phase transmission line is built consisting of No. 0 copper wire strung on cedar poles, spaced 100 ft. apart. At Kimberly the voltage is transformer to 480 for use in the mills.

To maintain a 100 per cent power factor on the transmission line, an old oil engine-driven generator was disconnected from the engine and by properly connecting it electrically to the line, it floats as a synchronous condenser. This is a General Electric 175-kv.a., 18-pole generator, with an exciter run by belt from the shaft of the generator.

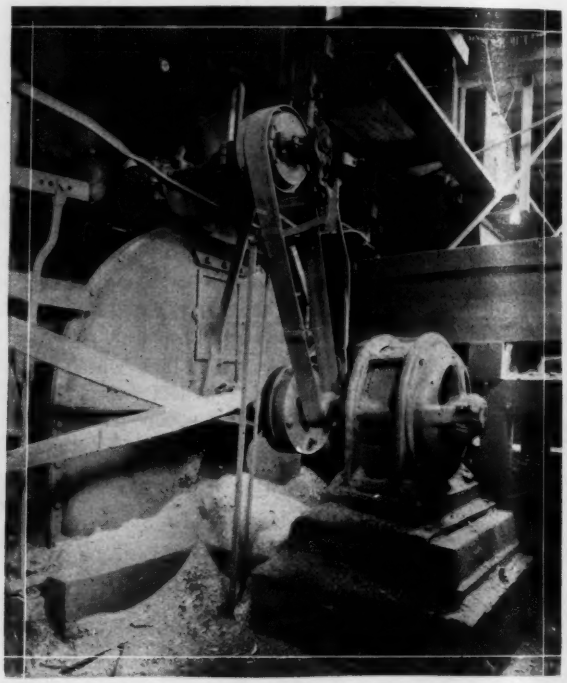


FIG. 7. INDUCTION MOTOR OF 15 HP. CAPACITY DRIVING 5 FT. BARKER

In the hydraulic plant at Kimberly are 2 350-kv.a. generators geared to water wheels, one being driven by 5, the other 6 75-hp. wheels which work under a head of 9½ ft. of water. In connection with this equipment, a 350-kv.a. generator runs as a synchronous condenser floating on the line to boost the power factor. This generator was also one which had been connected to an oil engine.

THE SPECIFICATIONS for concrete used in concrete chimneys as recommended by the General Concrete Construction Co. are as follows: The concrete in the foundation shall be mixed in the proportion of 1 part Portland cement, 3 parts clean sand and 6 parts crushed stone or gravel. The concrete in the chimney shall be a wet mixture of 1 part Portland cement, 2½ parts clean sand, 3 parts of 1-in. crushed stone and gravel.

Fire Protection for Office Building

UNION CENTRAL LIFE INSURANCE CO. INSTALLS MOST EFFECTIVE FIRE PROTECTION SYSTEM IN BUILDING AT CINCINNATI. BY C. B. GARRISON

THE modern office building is as near being "fire-proof" as it possibly can be made, and during construction, the "Safety First" principle in regard to fire protection receives the first consideration.

The public, as a rule, does not fully realize what precautions are taken by building owners and managers to insure the safety of their tenants and as a matter of efficiency, an example might be taken from the Union Central Building, Cincinnati, Ohio, the home office of the Union Central Life Insurance Co. This building

FIG. 1. VIEW OF UNION CENTRAL BUILDING DURING TEST OF THROWING STREAM FROM TOWER

is 38 stories in height from boiler room to the top. It has 32 rentable floors with a floor rental area of 244,646 sq. ft. It is composed of structural steel columns, and girders; the outside being lined with glazed white terra cotta. The floors throughout the building are fire-proof tile construction, over which 6 in. of concrete is placed, which is finished with cement as a flooring. The doors are covered with bronze, or metal reinforced steel doors; wire glass is inserted in them. All windows and door frames are metal, base-boards being slate. As a matter of fact there is no inflammable material exposed.

Two self-contained stairways are in the building; one runs to the 17th floor and the other to the 29th floor. These stairways are independent of lobbies or elevator shafts.

Every night this entire building of 8¾ acres of floor space is patrolled by 2 night watchmen.

The Ecco system of clocks is installed, comprising 92 boxes. Six trips are made through the building nightly

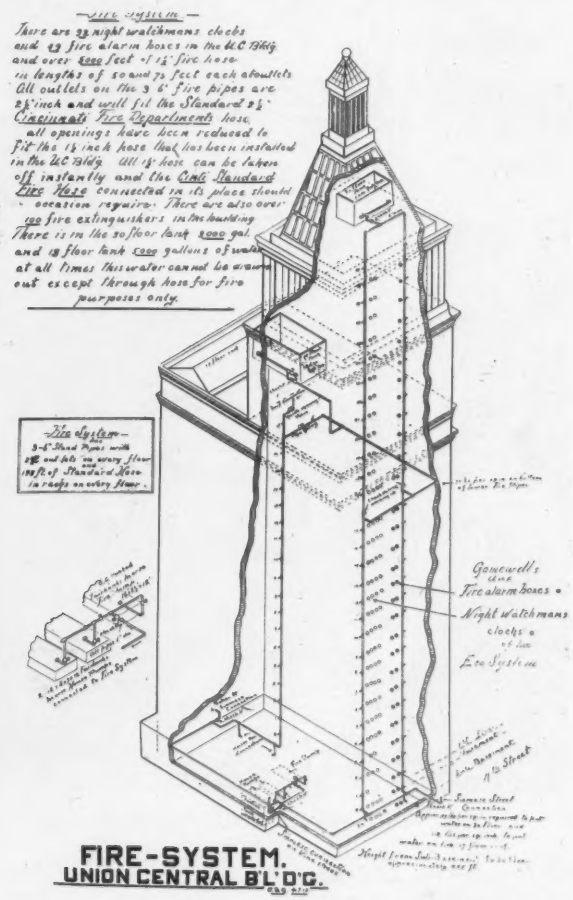

There are 23 night watchmans clocks and 43 fire alarm boxes in the U.C. Bldg and over 5000 feet of 1½ fire hose in lengths of 50 and 75 feet each at outlets All outlets on the 3 6" fire pipes are 2½ inch and will fit the Standard 2½ Cincinnati Fire Departments hose all openings have been reduced to fit the 1½ inch hose that has been installed in the UC Bldg All 1½ hose can be taken off instantly and the 2½ Standard Fire Hose connected in its place should occasion require. There are also over 100 fire extinguishers in the building There is in the 30 floor tank 2000 gal and 18 floor tank 1500 gallons of water at all times this water cannot be drawn out except through hose for fire purposes only.
Fire System
3-6" Steel Pipes with 2½ out lets on every floor and 150 ft of Standard Hose in racks on every floor.
Gamewell's Fire alarm boxes
Night watchmans clocks
Ecco System
FIRE-SYSTEM
UNION CENTRAL BL'D'G.

FIG. 2. DIAGRAM OF FIRE PROTECTION SYSTEM

and on Sunday, 552 boxes are rung nightly, the number of the box and the time of pulling being recorded in the engine room on charts.

In this building are 48 fire alarm boxes, 100 fire and 20 Pyrene extinguishers placed at convenient places. There are 5000 ft. of hose continually in racks on each floor in lengths of 75 to 150 ft. The water for this hose supply comes from 3 6-in. standpipes that connect to tanks on the 18th floor, and the 30th floor. These tanks

hold 5000 gal. of water for fire purposes, the tank capacity being 19,000 gal. The fire circulation is from the bottom, and service water about halfway up, which leaves 5000 gal. at all times in reserve for fire.

These standpipes connect to 3 steamer connections on streets in addition to being connected to one 16 by 8½ by 12-in. underwriters' fire pump and 2 12 by 18 by 7 by 12-in. duplex house pumps. All pumps are cross connected and are tested on the system at regular intervals. Fire alarm boxes are pulled each week to test the efficiency of the crew when responding to an alarm.

In order to test the efficiency of the fire system in the Union Central Life Insurance Co.'s building, Cincinnati, Ohio, Captain M. W. McIntyre, manager of the building, made arrangements with the Cincinnati Fire Department and the Ahrens Fire Engine Co. to demonstrate what their fire apparatus could do, if called upon to fight a fire. The test proved successful, and the following report shows the efficiency of fire pumps against the modern fire engine.

EFFICIENCY PUMPING TEST

Steamer—City Engine No. 44—double extra first size:

1300 gal. nominal capacity, representing the largest size steam fire engine in use.

Automobile—Ahrens-Fox model "A":

750 gal. nominal capacity. Equivalent to ordinary second size steam fire engine. Representative of the type in use by fire companies 20 and 46, Cincinnati. Both engines stationed at Third and Vine Sts., pumping from hydrant, up grade to Baker St. through double leads of 2½-in. fire hose, connecting to 6-in. vertical standpipe of the Union Central Life Insurance Building. First Test—100 ft. 2½-in. hose attached to standpipe on 18th floor, using 1¼-in. smooth bore nozzle:

Maximum nozzle pressures observed were as follows: Steamer, 95 lb., estimated discharge 449 gal. per min. Auto, 87 lb., estimated discharge 436 gal. per min.

The pressures recorded at the pumps in either case were somewhat beyond the 300-lb. reading mark of the pressure gages and in both instances the tests were interrupted and ended by the bursting of the fire hose near the engines.

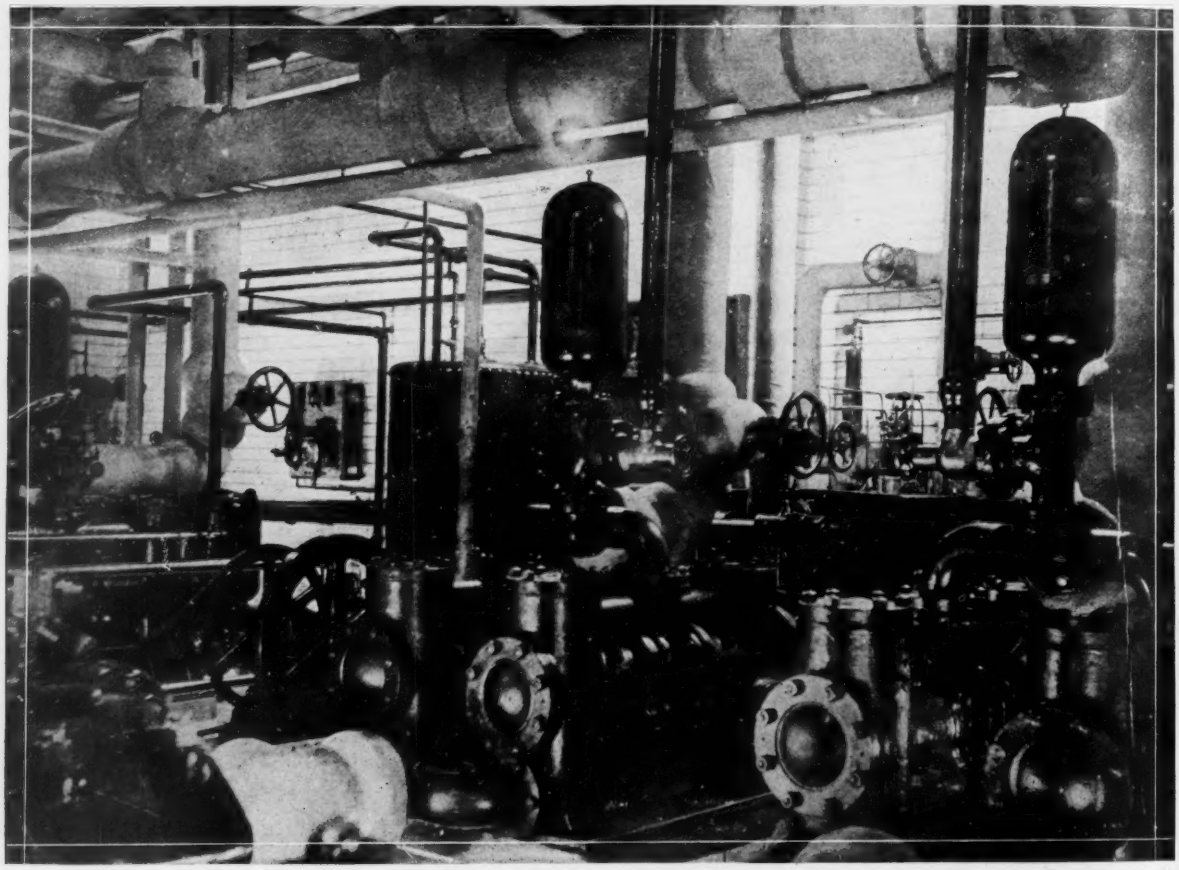


FIG. 3. FIRE PUMPS IN BASEMENT

Testing the efficiency of the house fire pumps, located in the basement of the building and pumping direct into the standpipe, pump pressures reading 300 lb. in the engine room developed a pressure of 120 lb. at the 18th floor, using the same nozzle as the fire engines and causing a delivery of approximately 510 gal. per min.

Following the tests at the 18th floor, a line of 2½-in. hose was attached to the upper terminal of the standpipe at the 28th floor. From this point, 150 ft. of hose was required to reach the balcony, encircling the observation platform on the tower. A 1⅛-in. nozzle was attached and an effective fire stream was projected into space.

The results observed were as follows:

Steamer—Maximum pressure 58 lb., 286 gal. per min.

Auto—Maximum pressure 80 lb., 335 gal. per min.

The pressure readings at the pumps again exceeded the range of the recording instruments. The tests were ended when the Auto fire engine burst a length of hose, as the maximum effect observed at the tower was reached.

These fire engines were situated one square from the building and the distance from the engines to the top of the building where the streams were thrown is over 475 ft.

Buying Efficient Operation

How Extra Pay for Special Care and Team Work May Increase the Output and Efficiency and Fatten the Pay Envelopes of the Operating Staff. A Premium Plan Whose Principle Can be Applied in Any Plant. By Frank G. Frost

THERE seems to be no good reason why a premium system for the payment of central station operators manufacturing kilowatt-hours should not lower the fuel cost of central station operation. It requires only a turn of the hand, due to improper adjustment of draft to the boiler furnaces, for a fireman during an 8-hr. station watch to waste fuel equivalent in value to several times his daily wage, and some sort of premium system by which the workmen receive additional compensation for increased efforts, has resulted in a reduction in the labor cost of production.

With modern steam turbines a difference of 1 in. in vacuum makes approximately a difference of 6 per cent in the number of pounds of steam required to generate a kilowatt-hour, so that a few leaks in the air piping, the neglect to turn on water, to seal a valve, or improper valve adjustment in the air pumps, will, in a few hours, cause a loss of fuel equivalent in value to several times the engineer's wage.

There is this difference between a workman in a factory and in a central station: the individual efforts of the factory workmen are usually given to the production of one article, while in a central station the concerted effort of several workmen is required to produce the article manufactured, the kilowatt-hour, but it is believed that a premium for increased effort will stimulate team work that will result in increased efficiency. To secure the best team work all station operators responsible for the efficient performance of the plant should share in a premium system. By intelligent and constant attention to duty the fireman can effect a greater saving than the engineer and should receive a large premium. While the duties of the switchboard operator have no direct bearing on the economy of the plant, with a premium system and a plant striving for maximum economy, the station operating results should be checked from hour to hour, so that the switchboard operator will be required to furnish meter readings to the firemen or watch engineer and should receive a portion of the premium.

The premium system described in this paper applies to an oil-burning plant at which the writer made tests, and all subsequent description, unless otherwise mentioned, refers to the conditions at this plant. The generating equipment consists of 2 600-kw. engine-driven units that are rarely used, 2 1500-kw., 1 3000-kw., and 1 5000-kw. turbine. The fuel oil analyzes approximately 19,000 B.t.u.'s per lb., and is uniform in quality. The circulating water for the condensers has a high range in temperature; in summer it is often as high as 105 deg. F., and in winter is rarely below 55 deg. F. The plant distributes from the buses approximately 1,650,000 kw.-hr. per month and is operated with 3 8-hr. watches a day, with one fireman, one engineer and one switchboard operator on duty for each watch. There are also oilers, machinists, boiler cleaners and helpers, but the firemen, engineers and switchboard operators are responsible for the efficient operation of the plant and are the ones to benefit by a premium system.

In all turbine stations with the turbo-generators clean and operating properly, the 4 variable items that affect the steam economy of the turbines are, steam pressure, superheat, load factor and temperature of circulating water to the condensers, and any premium system should provide a method of correction for season or other changes in these variables, so that, with maximum efficiency, the premiums will be approximately the same for all seasons of the year. In any plant where the operation and cleaning of the boilers are given proper attention the steam pressure and superheat will be practically constant.

In the plant described, the summer, winter, spring and autumn load factors were such that the maximum economy at which the plant could be operated with a given temperature of circulating water was practically the same for all seasons of the year. The method used to provide a correcting factor for the season changes in the circulating water temperature as described later.

Turbine tests had been made so that the steam curves of all the turbines were available; boiler tests were made so that the maximum efficiency at which the boilers could be operated was known. With this information it was a simple engineering problem to make allowances for the steam-driven auxiliaries and draw curves of the maximum number of kilowatt-hours that could be generated per gallon of fuel oil as shown on Fig. 1. These curves were found to be useful while making 24-hr. plant tests, corrections being made for any variation in steam pressure, vacuum or superheat. Test results were checked each hour and in the event of the number of kilowatt-hours generated for a given load was not on or near the curve, a careful search was made until the point of waste was found and corrected.

The turbines had a correction factor of 1 lb. of steam per kilowatt-hour for each inch of vacuum variation from 28 in.; the correction to be added to the amount of steam used by the turbine if the vacuum is less than 28 in. and to be subtracted if the vacuum is more than 28 in. (all vacuum readings referred to a 30-in. barometer). Due to the excessive temperature of the circulating water the cooling surface of the condensers was much larger than is usual in a plant where colder circulating water is available.

Tests had shown that for practically all station loads it was possible to produce a vacuum corresponding to a temperature of not less than 20 deg. F. above the temperature of the circulating water entering the condenser,

and all calculations for corrections in station economy due to the season changes in the circulating water temperature have been made on this basis. The curve of monthly maximum results, Fig. 2, has been drawn by fixing one point on the curve on the line of 78 deg. F., the average yearly temperature of the circulating water, from data from the curves shown in Fig. 1, making allowances for the Sunday load, which is approximately 50 per cent of the weekday load, and deducting the average amount of current used by the motor-driven auxiliaries, and for station lighting. The slope of the curve due to the variable economy of the plant caused by the season changes in the temperature of the circulating water is determined from the vacuum corrections described in this paragraph and the turbine steam corrections for changes in vacuum mentioned above.

The lower curve, Fig. 2, above which the premium system applies, has been drawn 0.7 of a kw.-hr. below, or for the yearly average temperature of the circulating water, 15 per cent below the curve of monthly maximum results. Premiums are to be paid the central station attendants only when the monthly number of kilowatt-hours distributed per gallon of fuel oil, plotted on the line of the average temperature of the circulating water for the month, is above the lower curve.

This system has been developed on the basis that the central station operators ought easily to produce results up to the lower curve, but to produce results between the 2 curves, and especially to approach the curve of monthly maximum results, requires skilled fire-

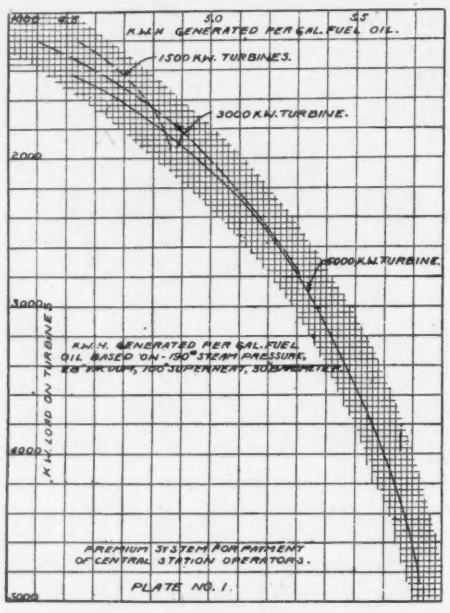

K.W.H. GENERATED PER GAL. FUEL OIL.
1500 KW. TURBINES.
3000 KW. TURBINE.
5000 K.W. TURBINE.
K.W.H. GENERATED PER GAL. FUEL OIL BASED ON 190° STEAM PRESSURE, 28" VACUUM, 100° SUPERHEAT, 30 BAROMETER.
K.W. LOAD ON TURBINE
PREMIUM SYSTEM FOR PAYMENT OF CENTRAL STATION OPERATORS.
PLATE NO. 1.

FIG. 1. MAXIMUM OUTPUT CURVES FOR THE GENERATING UNITS

men and engineers, team work and close attention to duty every minute while on watch. Since the first tenth of a kilowatt-hour above the lower curve is much easier to produce than the tenth just below the curve of monthly maximum results, the premiums should be graded. A tabulation of premiums is shown in Table I. These premiums are to be paid the station attendants in addition to a fixed sum and any increase in wages for years of service can be provided for in this fixed sum.

With a distribution of 1,650,000 kw.-hr. a month and the schedule of premiums given in Table I, and for the yearly average temperature of the circulating water, the saving to the central station and the amounts paid the station attendants in premiums each month, for each tenth of a kilowatt-hour distributed per gallon of fuel

TABLE I. SCHEDULE OF PREMIUMS FOR STATION OPERATORS

Tenth of kw.hr. Above Lower Curve Plate No. 2.	Each Fireman	Each Engineer	Each Switchboard Tender	Total Each Watch	Total Three Watches
1st Tenth.....	$2.00	$1.50	$0.75	$4.25	$12.75
2nd "	2.50	1.75	1.00	5.25	15.75
3rd "	3.00	2.00	1.25	6.25	18.75
4th "	3.50	2.25	1.50	7.25	21.75
5th "	4.00	2.50	1.75	8.25	24.75
6th "	4.50	2.75	2.00	9.25	27.75
7th "	5.00	3.00	2.25	10.25	30.75
Totals.....	$24.50	$15.75	$10.50	$50.75	$152.25

oil above the lower curve, Fig. 2, is shown in Table II.

In March, 1914, the 5000-kw. turbine was put in operation, which improved the station economy. On Fig. 2 is shown the monthly station operating results from April to February, inclusive, plotted on the line of average monthly temperature of the circulating water, also the results of 2 24-hr. tests made in October. While at this date this premium system has not been adopted, the operating results shown in Fig. 2, from April to

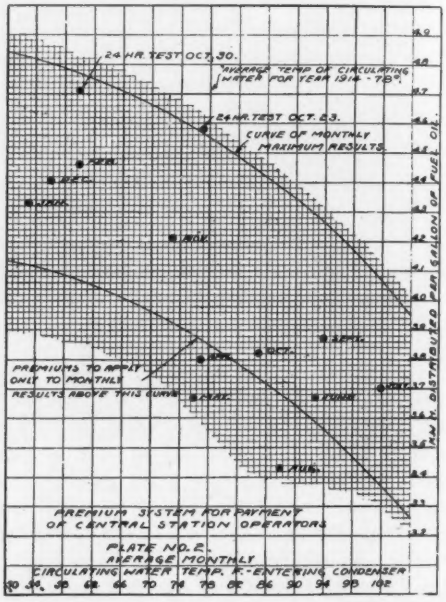

24 HR. TEST OCT. 30.
AVERAGE TEMP. OF CIRCULATING WATER FOR YEAR 1914 - 78°.
24 HR. TEST OCT. 23.
CURVE OF MONTHLY MAXIMUM RESULTS.
PREMIUMS TO APPLY ONLY TO MONTHLY RESULTS ABOVE THIS CURVE
K.W.H. DISTRIBUTED PER GALLON OF FUEL OIL.
PREMIUM SYSTEM FOR PAYMENT OF CENTRAL STATION OPERATORS.
PLATE NO. 2.
AVERAGE MONTHLY CIRCULATING WATER TEMP. F.-ENTERING CONDENSER

FIG. 2. MONTHLY RESULTS CURVES OF MAXIMUM PERFORMANCE AND PREMIUM PAYMENT BASIS

October, inclusive, average 0.04 of a kw.-hr. per month above the lower curve, while from November to February inclusive, the average per month is 0.3 of a kw.-hr. above the lower curve. This has nothing to do with the premium system but shows that the data obtained from the tests completed in October produced a marked improvement in the economy of the plant. In order clearly

to explain the application, it is interesting to note that if this premium system had been used the premiums for the 11 months plotted on Fig. 2 would be as shown in Table III, or a total average of $9.63 per month.

This premium system can be applied to any plant, either coal or oil burning, by predetermining the amount that the central station can afford to pay in premiums for certain increased operating efficiency and preparing a schedule of premiums that will produce these results as outlined in Tables I and II. In general application of this system, the curve above which the premiums

TABLE II. SAVINGS FOR EACH 0.1 KW.-HR. ABOVE PREMIUM BASIS CURVE, FIG. 2

Kw. Hr. Distributed Per Gallon of Oil	Total Gallons Oil Burned	Gals. Oil Saved Per Tenth kw.hr. Distributed Per Gal.	Equivalent Barrels Oil Saved	Saving Based On Oil at 75¢ Per Barrel	Premium Paid Workmen	Net Saving to Central Station
3.95	417,700	*10,900	255	$191.25	$12.75	$178.50
4.05	407,400	10,300	245	183.75	15.75	168.00
4.15	397,600	9,800	233	174.75	18.75	156.00
4.25	388,200	9,400	223	167.25	21.75	145.50
4.35	379,300	8,900	212	159.00	24.75	134.25
4.45	370,800	8,500	202	151.50	27.75	123.75
4.55	362,600	8,200	195	146.25	30.75	115.50
				$1,173.75	$152.25	$1,021.50

*For 3.85 kw.hr. per gallon oil, total oil burned 428,600 gallons.

will apply, as shown on Fig. 2, will be different for every plant, but this curve can be drawn from actual operating results for a year or from a series of station tests or by any other method that accurately determines the point above which the central station is willing to pay premiums.

In drawing this curve, care must be taken to provide for season changes in the circulating water temperature and season changes in the load factor that affect the economy of the plant, so that with the same degree of efficiency, the premiums will be approximately the same

TABLE III. PREMIUM PAYMENTS FOR RESULTS SHOWN ON .. FIG. 2

Tenths of kw.hr. Above Lower Curve, Plate No.2		Firemen	Engineers	Switchboard Tenders
April.....	Below	.....	.....	.....
May.....	"	.....	.....	.....
June.....	.8	$1.60	$1.20	$0.60
July.....	3.4	6.95	6.15	3.60
August.....	Below	.....	.....	.....
September....	3.0	7.50	5.75	3.00
October.....	.9	1.80	1.35	.68
November.....	2.9	7.20	5.05	2.87
December.....	3.1	7.85	5.47	3.15
January.....	2.1	4.80	3.45	1.88
February.....	4.0	11.00	7.50	4.50
Totals for 11 Months.....		$50.70	$35.92	$20.28
Average Per Month:...		$ 4.61	$ 3.27	$ 1.85

for all seasons of the year. The curve of monthly maximum results is not essential to the premium system, but has been used in this paper to describe its development and is an interesting goal for station operators to have before them. With the load curves of the station and the data from Fig. 1, curves of maximum results for each station watch can be drawn.

Aside from the premium system feature of this paper, it is intended to show that a careful analysis of operation and definite determination of the maximum economy that ought to be obtained in any plant is a step towards improved efficiency.—The Jovian.

Washing and Cooling Air for Generators

INCREASED OUTPUT AND DECREASED MAINTENANCE COST RESULT FROM USE OF COOL CLEAN AIR IN GENERATORS. BY FRANK C. PERKINS

THE accompanying illustrations show the installations for washing and cooling air for steam turbine generators at the United Electric Light Plant, New York, and the Marion Public Service Station as developed at Boston, Mass.

It is pointed out that as the capacity of the electric generator is directly dependent upon its temperature, which in turn depends upon the air conditions, an ample supply of cool, clean air is of great importance. Dust or soot deposited within the machine greatly reduces the efficiency of air as a cooling medium. The accumulation of dust and dirt is particularly rapid when the ventilating air contains oily vapor, as is generally the case in all engine rooms. Perhaps the most serious effect of dirty air and excess heat is to reduce greatly the life of the insulation of the machine.

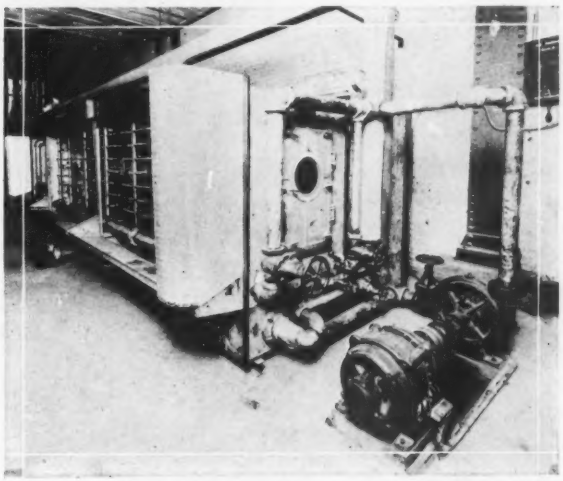


FIG. 1. AIR WASHING EQUIPMENT OF THE UNITED ELECTRIC LIGHT & POWER CO.

It may be stated with assurance that abroad, especially in Germany, no turbo-alternator is operated without the use of an air filter of some type. It is a notable fact that the percentage of loss of generators through burnouts due to clogged air passages, etc., is far less abroad than in the United States where, as a rule, little attention has been paid to conditioning air for generators. The type of filter used abroad is largely the dry or cloth screen type, which is more or less dangerous because of its liability to destruction by fire with consequent danger of flames being drawn into the generator. This cannot be the case with the spray type of filter or washer and cooler as illustrated.

The cooler the air delivered to a generator, the greater is the load it can safely carry. As generators usually reach maximum efficiency at or above full load, the spray washers produce the double benefit of high efficiency and full rated capacity. Cooling the entering air

from 90 to 70 deg. F., which can be done with air at a relative humidity from 35 to 40 per cent, results in increasing the capacity of the generator by approximately 18 per cent. This is based on taking the load at 77 deg. F. as 100 per cent. The ratio of the permissible loads at 70 and 90 deg. F. is 105 : 89.

In hotter weather, or where ventilating air is taken from the hot engine room, this gain is much greater. Even in moderate weather the benefits are very marked. Results of recent tests with air washers show cooling results ranging from 11 to 19.25 deg. F., depending on the time of year, but in every case resulting in cooling the air practically to the temperature shown by the wet bulb thermometer.

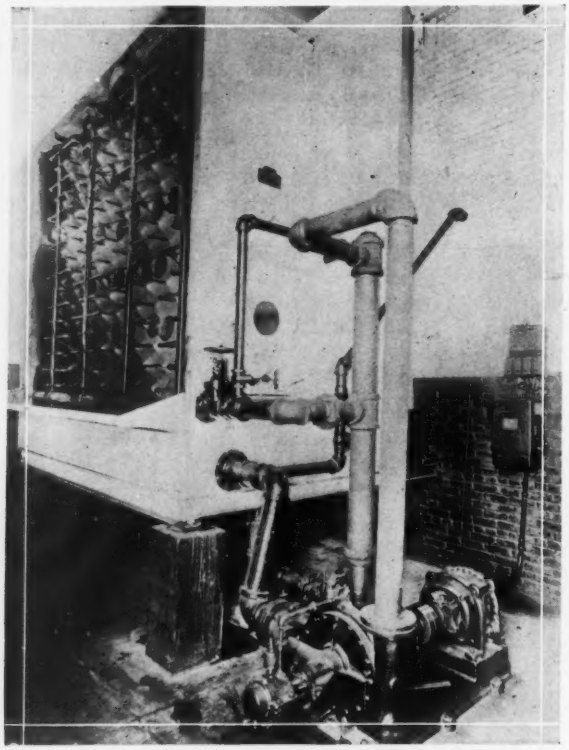


FIG. 2. WASHING AND COOLING AIR FOR THE MARION PUBLIC SERVICE STATION

It will be seen that an increase in the capacity of a generator has a distinct money value. An average gain of only 5 per cent on a 5000-kw. machine means an increased capacity of 250 kw. At $20 a kw. a yr., this gives $5000 increased earning capacity in one year. As already pointed out, dirt and soot carried into the generator will prevent it from being properly cooled by the ventilating air. Much more important than this, however, is the effect on the life of the generator. This is particularly true in the vicinity of steel plants and coal mines, when carbon and iron dust, both unusually severe in their action upon insulation, are present in large quantities.

It is claimed that a large percentage of all short circuits and burnouts of generators is due to foreign matter breaking down insulation resistance. Since a clean generator is comparatively free from such troubles, it is clear that an air washer may prevent a serious accident with a resulting loss, many times exceeding the cost of its installation. The cost of cleaning a large generator is high, and where the air is unwashed, has to be undertaken at least twice a year. This can be largely avoided by the use of the spray air washers. Any large turbo-unit, completely out of commission for 10 days at a time for cleaning, represents a definite expense, the amount of which should be added to the other losses due to unwashed air.

One form of spray nozzle used is composed of 3 parts, one of which is the removable turbine center. This center is held stationary in the nozzle, so that there are no moving parts to wear out. The water, in passing through, is given a rapid rotating motion. A central driving jet impinging on the rotating water at the orifice ejects it as a fine, dense uniform spray.

It may be stated that these nozzles are operated at a low pressure and give a fine spray. The central driving jet fills in the center of the spray, thus giving it a solid conical formation.

On account of the design of the spray nozzle, the water is atomized in a dense homogeneous mist, entirely filling the spray chamber. The air passing through this dense mist is brought into repeated contact with fine particles of water, which in falling precipitates all dust contained in the air. To insure the complete removal of any dust particles which may have passed through the first set of sprays, the air is again subjected to the action of cross scrubbing sprays placed beyond the first set of sprays.

The air is next passed through a screen, which removes a large part of the entrained water and prevents any large stratum of air from passing through the washer without coming in contact with wet surfaces. All free moisture in the air is then removed, by the eliminator plates, the air leaving the washer clean and dry, but with a relative humidity of 100 per cent. Spray atomizing screens are used to atomize the water beyond the possibility of any spray action alone.

The nozzles are of naval bronze with removable centers, while the atomizing and eliminator screens are made of copper and the eliminator plates of aluminum, thus securing highest resistance to corrosion from all causes and consequent long life. A strainer of the pot type is placed between the pump and nozzles, thus preventing clogging and permitting all foreign matter to be flushed directly to the sewer by means of a quick opening drain valve. The inside of the perforated cylindrical screen is subjected to a high velocity jet of water, thus effectively removing all material having a tendency to adhere to the screen and requiring no other cleaning or brushing. This arrangement makes it unnecessary to clean the water box except at long intervals.

It is maintained that the 2 important accomplishments of cooling and cleaning air for generators are thoroughly performed in the spray air washer and it has been demonstrated beyond question that there is a resulting gain in efficiency and capacity and a saving in maintenance as well as a longer life of the machine.

MIXING OIL with the gasoline is the very best way to oil a 2-cycle. A pint to 4 gal. is about the right proportion.—The Gas Engine.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Practical Electrical Engineering

DISTRIBUTION OF ENERGY; DETAILS OF OVERHEAD AND UNDERGROUND SYSTEMS

DIRECT-CURRENT distribution of electrical energy other than for plants of small size, and for short distances, has become practically obsolete, therefore this section will be confined to alternating-current distribution only. The methods followed in secondary distribution are entirely controlled by local conditions and differ materially for various classes of service; but the general requirements are that the service shall supply current for lighting or power, or both, either continuously or intermittently. Continuity of service is absolutely essential under all conditions.

Nearly all motors operated by alternating current are of the induction type, either 2 or 3-phase, and usually employ the squirrel-cage type of rotor. It is a characteristic feature of efficient motors with close speed regulation to draw a large starting current at low power factor, thus affecting the voltage of the transformer and probably causing the lamps connected to its low-tension circuit to dim. An occasional dimness of the lamps is not particularly objectionable, but when the motor is frequently started and stopped, the results are not satisfactory without potential regulators. It is best, in such cases, to supply lines and transformers for lighting separate from those for power, especially as the best lighting results are secured by using a single-phase transformer with a maximum low-tension voltage of 220.

Best results for power are obtained by using 2 transformers on 2-phase systems, and 3 transformers on 3-phase systems with a maximum low-tension voltage of approximately 440. A considerable saving owing to the simplicity of connections and the cost of erection can be secured in most instances by adopting a 3-phase transformer for power supply. When lighting forms a considerable portion of the total load, it is best to run separate high-tension feeders for the lighting load.

For congested power service it is often advisable to install a separate transformer for each motor. This will be found profitable when the cost of low-tension wiring is considered, since it allows a transformer to be placed as close as possible to the motor. When there are a number of motors, however, say of 4 or 5 hp. capacity, they can usually be supplied from one set of transformers. When there are 2 motors, one of 50 hp. and one of 5 hp. capacity, the conditions may not be favorable for connecting both motors to the same transformer or to the same set of transformers.

Where there are 4 or more motors of equal capacity connected to one set of transformers, the starting of one does not appreciably affect the transformer voltage and so does not impair the operation of the other motors. If one motor is much larger than the rest, it should be supplied with a separate transformer.

In every instance, whether the load is isolated or congested, it is preferable to connect the low-tension windings of the transformers in delta for 3-phase motors, the 3 wires being of equal size. For 2-phase work, the phases are usually kept separate and 4 wires of the same size are required. Where the 3-wire, 2-phase system is in vogue, the wire common to the 2-phases is of a size 50 per cent greater than either of the outside wires.

When several transformers are operated in parallel, it is essential that they have the same ratio of transformation and the same regulation. If the ratio of transformation is different, the low-tension voltage will be different, and the one with the highest voltage will feed through the low-tension windings of the others and thus a steady loss occurs. Also, the transformers thus connected must have the same voltage regulation since they do not divide the load in proportion to their capacity, but depend upon their regulation; thus, if 2 transformers of the same capacity but different in regulation are connected together, the one with the closer regulation takes the larger load and is thus in danger of being overloaded.

It is good practice to supply any one length of main with transformers of the same capacity, type and make. Overhead, single-phase, 3-wire mains for lighting should consist of 3 wires of equal size, which allows repairs and connections to be made to any one section and prevents trouble in any one section from affecting the whole main. Whether the mains be underground or overhead the voltages generally found best for this work are from 110 to 120 v. between the neutral and the outside wires and from 220 to 240 v. across the outside wires. The reason for installing a neutral of the same size as the outside wires is due to the possibility of all of the load being connected to one side of the main with no load on the other side.

If such were the case it would cause the neutral wire to carry a load equal to that of the outside wires and its carrying capacity would be so taxed that the drop in potential would be excessive. It is also good practice to omit fuses from the neutral wire since the blowing of a fuse would result in danger of burning out of all apparatus connected to the side of the system carrying the smaller load. With 50 lamps burning on one side

of the system and 100 on the other side, the blowing of the neutral fuse causes the 50 lamps to burn in series with the 100 lamps, thus raising the voltage on the smaller number of lamps. The weakest of the lamps on the lightly loaded side will burn out first, throwing a greater strain than ever on the remainder, which will burn out one after another.

Pole Line Distributing Systems

Distributing systems in which the power and service wires are carried upon poles, with the transformers also mounted on the poles, are the most common in this country. Hard-drawn copper wire is the usual form of conductor, although aluminum wire is beginning to be used. Hard-drawn copper wire should be used when it is necessary to have long spans requiring a conductor of great tensile strength. Soft-drawn copper wire has a tensile strength of from 34,000 to 35,000 lb. per sq. in., while hard-drawn copper wire has a tensile strength of from 60,000 to 70,000 lb. per sq. in., and a resistance only 2 to 4 per cent greater than the soft-drawn wire.

Often a medium hard-drawn wire is used, having a tensile strength of 40,000 to 45,000 lb. per sq. in. Such wire is much stronger than the annealed wire and is much easier to handle than the hard-drawn wire. The

GAGE B&S	AREA IN CIRCULAR MILS	WT. IN LB. PER 1000 FT.	ULTIMATE TENSILE STRENGTH	PERMISSIBLE TENSION WITH A FACTOR OF SAFETY OF 5
0000	211600	640.73	5640	1128
000	167805	508.12	4480	896
00	133079	402.97	3553	711
0	105592	319.74	2819	564
1	83684	253.43	2235	447
2	66373	200.88	1772	344
3	52633	159.36	1405	281
4	41742	126.40	1114	223
5	33102	100.23	884	177
6	26250	79.49	700	140
7	20816	63.03	556	111
8	16509	49.99	440	88

FIG. 1. PROPERTIES OF COPPER WIRES

wire should be free from scale, flaws and seams; in size it should not vary from its nominal gage, variations of 1 to 2 mils being the largest permissible, and its conductivity should not vary more than 2 per cent from the value given in the wire table for that particular size of wire. The table, Fig. 1, gives the strength of copper wire.

When wire is strung on poles, it is subjected to serious mechanical strains, due to its own weight, to normal tension, to variations in the length of the wire on account of the differences in temperature and to loads caused by wind and ice. These strains must be taken into account in the erection of the line or serious trouble is likely to occur.

When a wire is suspended between 2 supports it takes a curve technically known as a catenary. The exact solution of this curve is extremely complicated, and as an illustration of the law an approximation will be used, the result only being given, which is accurate enough for practical purposes. If L is the length of the span AB, Fig. 2, or the distance between the poles, d the maximum deflection or sag, W the weight of the wire in pounds per foot, and T the maximum tension given in the last column of Fig. 1, then we have the equation shown in Fig. 2.

This equation shows that with a given wire, the tension varies inversely as the deflection for a given span, and for given tension and wire the deflection must increase with the square of the span. Obviously, decreasing the span and increasing the deflection decreases the tension and renders the construction more secure. Decreasing the span, however, increases the cost of construction, and increasing the deflection increases the danger of the wires swinging together in the wind. To obviate this danger the deflection should not exceed twice the horizontal distance between the wires.

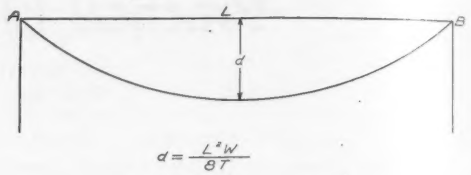


FIG. 2. THE CATENARY CURVE

Glass insulators are generally used on both the high and the low-tension sides of the distribution systems since they are much cheaper than porcelain insulators which are usually used on high-voltage transmission work. Glass insulators are made in solid, double and triple petticoat types. In high-tension work, trouble was originally experienced by leakage currents from the wire over the face of the insulator to the pin. This not only caused a loss of power, but owing to certain chemical changes that took place in the pin, due to the passage of the current, caused the pin to decay rapidly. This trouble was obviated by constructing the insulators with one or more petticoats, thus greatly increasing the distance which the static charge has to travel.

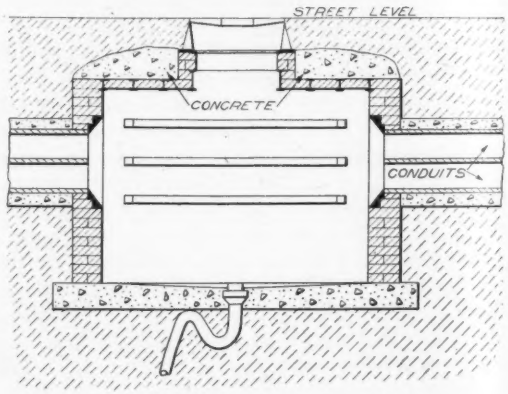


FIG. 3. TYPICAL MANHOLE FOR UNDERGROUND SERVICE

Water on the surface of the insulator increases the static discharge and for this reason the outside petticoat is made with teats around its lower edge. Moisture follows these teats to their ends and then drops off, thus preventing its creeping on the under side of the petticoat. The insulating strength depends upon the insulator surface and therefore the number of petticoats.

Underground Distributing Systems

This system of distribution, although more expensive in first cost, adds greatly to the public safety by doing away with masses of overhead wires. The placing of

wires underground has necessitated the design of special transformers, distributing cables and conduit systems.

Without considering the use of tunnels as a means of carrying underground wires or cables, there are in practical use, 2 systems of laying underground cable, the "solid system" and the "drawing in system." The former consists in laying the lead or steel covered cable directly in the earth without the protection of a box. This method is used principally in private grounds where there is no danger from injury by outsiders excavating.

Drawing in system provides for future expression and admits installing, testing and repairing and removing or changing cables without again disturbing the surface of the ground. This system consists of a conduit containing any desired number of ducts or chambers laid in the ground and intersected at convenient intervals by manholes through which access may be had to the several ducts.

Conduits are made from a variety of materials, such as fiber, wrought-iron pipe, wood, vitrified clay, etc. The fiber conduits are made from wood treated with compounds which make them proof against attacks from acids and water, and are laid in a bed of concrete to

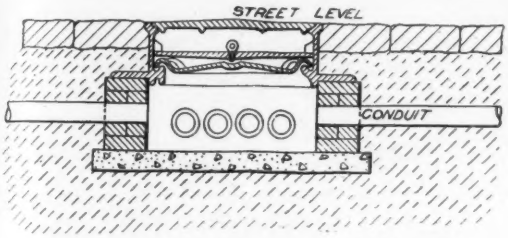


FIG. 4. MANHOLE WITH AUXILIARY COVER

insure a permanent installation. Wrought-iron conduits consist of regulation pipes with threads cut so that the ends of the sections butt firmly together under the couplings.

Vitrified clay conduits are made in short sections varying with the number of ducts. The clay presents a smooth, hard surface which resist the action of gases, etc., and offers little friction to the insertion of the cable. After the sections are laid the whole is surrounded by a concrete bed which forms a moisture-proof coating. In all cases the ducts should be perfectly smooth inside and have no projections, particularly at the joints. In order to preserve the cable from injury, it is best to draw a mandrel through the duct before the insertion of the cable. Lateral conduits from manholes to buildings may be made of clay pipe or some other cheap material.

Manholes in underground distributing systems are openings from the surface of the ground to the conduit by which the cables may be inspected; these holes are located wherever there is a turn in the conduit system and on long, straight stretches of conduit line should be placed at least every 500 ft. Manholes are built of brick or concrete with a cast-iron frame to support a cover; their size and shape depends upon the conditions of service, although a large, deep manhole is desirable in any system. Where there is any danger of gas collecting in the manhole, the cover should be perforated to allow it to escape. The manholes are frequently provided with 2 covers, the lower one being locked and resting upon a rubber gasket to prevent the entrance of surface water.

Cross-section of a manhole is shown in Fig. 3; the construction varies with the location and service. A serviceable manhole is constructed with an 8 to 12-in. wall of hard burned sewer brick, laid in a full bed of mortar and erected upon a solid 8-in. bed of concrete, entirely covering the bottom of the hole. The walls are corbelled in to receive a cast-iron frame and cover, or if the manhole is large the walls may be built up straight and the roof supported by I-beams which are bricked into the wall at either end. A drain and trap connecting to the lowest point in the manhole floor should be provided.

Cables in the manhole should be as neatly disposed of as possible and still avoid sharp bends. In no case should they be used as a means of entrance and exit; a ladder should be provided for that purpose.

In some distributing systems, it is necessary to provide more numerous points on the conduit at which power may be taken, than are supplied by the manholes. In such cases, handholes are provided which intersect

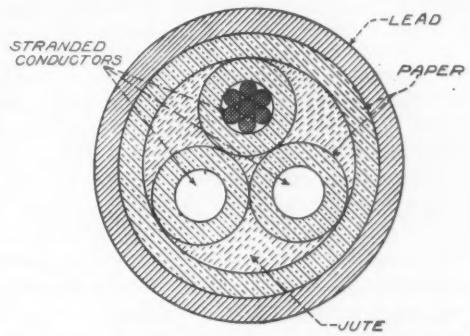


FIG. 5. CROSS SECTION OF CABLE USED IN UNDERGROUND DISTRIBUTION SYSTEMS

the conduit, and usually consist of iron boxes supported on brick or wooden walls having the cover flush with the ground level, as shown in Fig. 4.

Figure 5 shows a cross section of a cable used for underground distributing systems. The stranded conductors form 3 units and are insulated by a specially prepared substance, and are impregnated with an insulating compound. The 3 units thus formed are surrounded by more insulating matter and the interstices packed with jute. The whole is then covered with a heavy sheath of lead.

Electrolysis

All lead-covered cables, water pipes, gas pipes, etc., act as conductors of stray electrical currents and for ground return of electric railway systems. Whenever these currents leave the cables or pipes, a certain amount of pitting occurs which, if continued long enough, will entirely destroy the conductor. This pitting or electrolysis is caused by the molecules composing the pipe or cable being carried to the earth by the electrical current. Since damp earth is a better conductor than dry earth, the current leaves the cable at the damp places along the route and it is at such places that electrolysis takes place. The extent of the electrolytic action

depends upon the proximity of the cables to the electric railway, the distance the cables parallel the electric railway, the conductivity of the soil and the general conductivity between the cable and the track which it parallels.

If current causing the trouble is a generator operating with the negative brushes grounded, the best protection for the cables is metallic connection directly to the negative ground wire. This offers a good path to any stray currents picked up by the cable and prevents any electrolytic action by the current leaving the cable in the moist earth or exchange of current between sheaths and adjacent cables. If there are more cables than one they should be connected together at frequent intervals so as to make the resistance as low as possible and to prevent currents passing from one cable to another by any path other than metallic conductors. Under some conditions, the electrolytic action can be reduced by a ground plate from the cable itself. Such a plate should be located near the station or at the point which offers the best path to an electric current.

Power Factor Regulation

Action of Phase Advancer in Regulating Power Factor of an Induction Motor

IN A discussion at the annual convention of the Brooklyn Section of the National Electric Light Association on that part of the 1915 report of the N. E. L. A. committee on electrical apparatus taking up the use of phase advancers as an economical means for regulating the power-factor of individual motors, G. L. Knight, designing engineer of the Edison Electric Illuminating Co., of Brooklyn, gave the following interesting explanation of how the phase advancer operates, what its advantages are, and how it differs from the synchronous condenser:

The phase advancer bears the same relation to an induction motor as a direct-current exciter bears to the synchronous condenser, for the phase advancer supplies current at slip frequency to the field of the induction motor. The machine mentioned in the N. E. L. A. report is a 600-hp., 60-cycle wound-rotor, slip-ring induction motor of 5 per cent slip, with an 11-kv.a. phase advancer driven by a 1-hp. induction motor, as shown in the accompanying illustration. In this case the operating conditions are as follows:

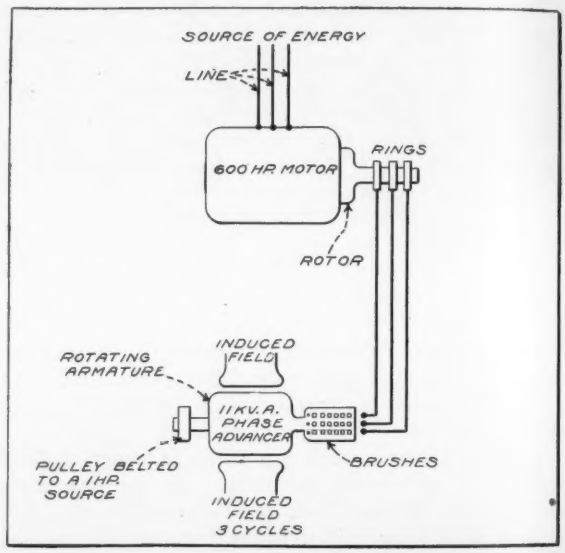
1. The source of energy supplied the 600-hp. motor is 60 cycles.
2. The speed of the 600-hp. motor under load, therefore, corresponds to 57 cycles.
3. The frequency of the current in the rotor of the 600-hp. motor is 3 cycles.
4. The frequency of the current supplied the collector rings of the 600-hp. motor from the brushes of the 11-kv.a. phase advancer, these brushes securing their current from the rotating armature of the phase advancer, is 3 cycles.
5. The frequency of the flux in the field of the 11-kv.a. phase advanced is 3 cycles.

In the case of the synchronous motor these values would be as follows:

1. Source of energy, 60 cycles.
2. Speed of the motor, corresponding to 60 cycles.
3. Frequency of the current in the rotor, 0 cycles (direct current).
4. Frequency of the current at the collector rings of the motor, 0 cycles (direct current).
5. Frequency of the flux in the field of the exciter, 0 cycles (direct current).

Just as a synchronous motor may be operated without receiving direct-current excitation into its revolving field, an induction motor may be operated without receiving 3-cycle excitation from an outside source into its rotor. In both cases the motors draw magnetizing current at 60 cycles from the line at lagging power-factor. This magnetizing current which goes into the stator reaches the rotor by induction or transformer action.

The synchronous motor, however, may have excitation from an external source gradually applied to its rotor, thereby raising the power-factor of the current drawn from the line approximately to unity. The same holds true for a slip-ring induction motor, except that the excitation must be alternating current and must be at slip frequency, in this case 3 cycles.



NATURE AND CIRCUITS OF PHASE ADVANCER USED WITH AN INDUCTION MOTOR

Excitation of a synchronous motor may be increased still further and the power-factor raised from unity to leading. The same thing holds true of an induction motor with a phase advancer.

Field flux of the phase advancer can be maintained at precisely the required frequency of 3 cycles, on account of the fact that the phase advancer has no definite poles and runs at no definite synchronous speed. The point is that the field of the phase advancer is an induced field, the current which induces it is at slip frequency or at 3 cycles, and, therefore, the field flux must also be at 3 cycles.

The advantage of the phase advancer is that it can be applied directly to existing slip-ring induction motors now in service and overcome the disadvantages which their low power-factor produces.—Electrical World.

Another Lap Seam Disaster

CRACK ALONG THE RIVET LINE HIDDEN FROM INSPECTOR BY LAP, RESULTS IN DEATH OF ENGINEER AND INJURY OF WORKERS

AT 7:40 on Monday morning, Oct. 11, the horizontal tubular boiler in the shoe factory of Strong and Garfield, East Weymouth, Mass., let go, demolishing the power plant, killing the engineer and injuring several employes of the factory. A crack which had developed along the outer row of rivets, due to the working of the seam, was hidden by the inside lap, so that although

FIG. 1. AFTER THE EXPLOSION; DEMOLISHED POWER HOUSE, BOILER AND FRONT SHEET

regularly inspected, the sheet gradually weakened, until the movement due to the Monday morning raising of steam pressure caused rupture and accompanying disaster.

Built in 2 courses of 1 sheet each, with double riveted lap longitudinal and single riveted girth seams, the boiler was 16 ft. by 60 in., with 92 15-ft. 3-in. tubes, expanded and beaded into ½-in. heads. The sheet was ⅜ in. thick, with strength of 55,000 lb., rivets 13/16 in. pitched 3¼ in. staggered, but, as shown in Fig. 3, there were radial cracks running back from the rivet holes, and the rivets showed that the holes were punched full size before the plates were rolled and that some of the holes did not come true.

Examination of the sheet showed that the crack was of long standing and that the last break was in places through less than 1/32 in. of metal. Inspection was made July last, but as the inside edge of the plate came to the light line of Fig. 3, neither the lap cracks nor the rivet

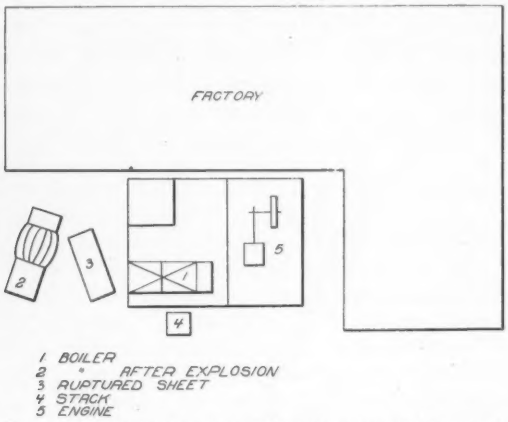


FIG. 2. PLAN OF PLANT AND POSITIONS OF EXPLODED BOILER

hole cracks could be seen, and the boiler appeared to be in good shape, so that the inspector was obliged to grant a certificate. He allowed 80 lb. pressure, though the legal limit was 84, but even the allowed limit was seldom reached, as 20 to 30 lb. lower pressure met all requirements of the plant most of the time, and a short time before the explosion the pressure was between 50 and 60 lb.

FIG. 4. SHEET AND LAP SEAM BREAK AND TORN FRONT END

FIG. 5. NEAR VIEW OF TORN EDGE OF SEAM

"Breathing" of the boiler evidently started the crack, assisted in its action by those rivet hole cracks which ran lengthwise of the seam, and the mischief increased until with the raise of pressure from zero on Monday morning, the last thin shred gave way, and the front sheet tore

apart the whole length of the seam, on the outer row of rivets, tore between rivet holes on the girth seam that held the front head, and sheared the rivets on the second girth seam clean. The sheet spread out practically flat and dropped free from the boiler in its flight, while the boiler was carried back some 20 ft. over debris, struck on the back end and turned over. Several tubes were pulled clear of the heads, and one was thrown some 200 ft.

Water column and steam gage piping were found to be in good condition and the fusible plug intact so that "low water" will not be available as an amateur explanation of the explosion.

This seems a clear case of danger that cannot be safe guarded so long as lap seams are permitted. Massachusetts boiler laws are excellent, and this construction is no longer permitted for boilers over 36 in. diameter or carrying over 100 lb. Also, the allowed pressure is reduced for every 5 yr. of service, even if the boiler appears all right. Engineer Cornelius Condrick, who was killed, was a competent engineer, with years of experience, 10 yr. in his last position, held a first class license and was known as a skilful, careful man who never took unnecessary risks.

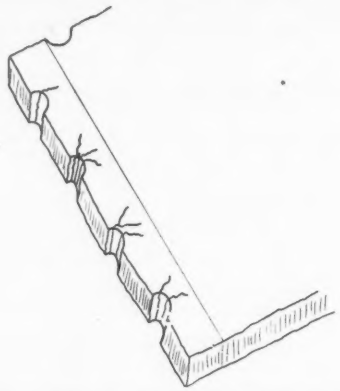


FIG. 3. SKETCH OF INSIDE OF RUPTURED SHEET, CRACKS RUNNING FROM RIVET HOLES, AND LAP LINE OF INNER EDGE OF SHEET

But the seam weakened and gave way under conditions and at a pressure that no human foresight could have predicted. And the only safeguard against similar disasters seems to be abolition of the lap seam for longitudinal joints and requiring drilling of rivet holes after rolling, or such reaming after punching as will insure that all punching cracks are removed.

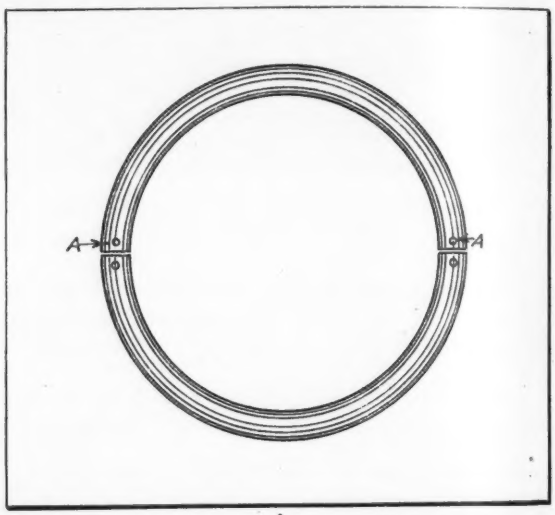
U. S. CIVIL SERVICE COMMISSION announces an examination for surveyor, Dec. 8 and 9, 1915, to fill vacancies in positions of U. S. surveyor and transitman in the General Land Office, and vacancies as they may occur in positions in any branch of the service requiring similar qualifications. Entrance salary for transitman ranges from $100 to $110 a month, and a graduated per diem in lieu of subsistence, and for U. S. surveyor from $125 to $150 a month, and a graduated per diem in lieu of subsistence. Apply for Form 1312, stating the title, Surveyor (Male), to the U. S. Civil Service Commission, Washington, D. C.

Remedy for Leaky Stuffing Box

MANY engineers find it impossible to prevent steam and water from blowing by the piston rod and valve stems of an engine, due to the fact that the rods become worn and give too much clearance space around the rod in the bottom of the stuffing box, and also at the bore of the packing gland. The result is that the packing will work into the cylinder or by the packing gland.

To close up this clearance, many engineers make, or have made, a ring of babbit or brass to fit the bottom of the stuffing box next to the packing gland. A writer in International Marine Engineering has found that these rings take up too much space in the stuffing box, so that it is impossible to get a sufficient number of packing rings in the stuffing box to make a tight job; but if a ring made of No. 5 or 6 B. and S. gage copper wire is worked out to a good fit around the rod, this ring does not take up nearly so much space as a ring of babbit or brass.

These rings are made in halves, as shown in the illustration. A small hole is drilled in each half of the ring, as shown at A, A. This is to keep the ring in place; while the packing is being placed in the stuffing box, the 2 halves of the ring are fastened together with small wires. After placing them around the rod, the wire ring is taken up by filing away at the 2 joints. The writer has had a set of these rings in use for the last 2 yr., and finds that they work satisfactorily in every respect.



WIRE RING FOR LEAKY STUFFING BOX

There is another point about this arrangement which is important. When the rings are made in 2 parts, they are kept in shape when placing them over the rod; whereas, when the ring is made with only a single joint, it has to be sprung over the rod, and will not make a tight fit around the rod on account of its being pulled out of shape.

WIRELESS TELEPHONE messages from Arlington, Va., to Paris, France, a distance of 3800 mi., on Oct. 21, marks the initiation of another achievement of world-wide importance to mankind.

News from Washington, D. C.

WATER POWER DEVELOPMENTS IN WASHINGTON; GOVERNMENT BULLETINS. BY A. P. CONNOR

THE recent reference to water power development in the city of Washington which was referred to in the article on page 590 of Practical Engineer for June 15, has apparently revived the interest in this project and indications are favorable to its being actively taken up as soon as Congress convenes. During the last few weeks the President, the Postmaster General, the Commissioners of the District of Columbia and the U. S. Army Engineers have expressed themselves favorably in the matter and it was discussed definitely by them. It is proposed to obtain an appropriation of about $16,000,000 from Congress to prosecute the undertaking. The work calls for the construction of a dam about 115 ft. high, and the development of about 8000 hp. to start with. The impounded water will also be drawn upon for the domestic purposes of Washington.

GOVERNMENT BULLETINS

THE FOLLOWING list of bulletins issued by the Bureau of Mines are of particular interest to engineers and those interested in power enterprises and can be obtained from the Government Printing Office for the amount stated in each case. Their cost is simply to cover the mere cost of printing and readers will find themselves amply repaid in value both in the amount of information given and in the size of the bulletins. They are all entirely practical and highly recommended. A certain number of all these bulletins are given away free; but as this number is necessarily small, it is always best to send the amount or price of the bulletins that are desired to the Government Printing Office and the order for the papers or bulletins desired. There is no charge for postage on the bulletins.

PUBLICATIONS THAT MAY BE OBTAINED ONLY THROUGH THE SUPERINTENDENT OF DOCUMENTS

ALL COMMUNICATIONS for these publications should be addressed to the Superintendent of Documents, Government Printing Office, Washington D. C.

Bulletin 7. Essential Factors in the Formation of Producer Gas. 10 cents. Describes laboratory experiments bearing on the rate of formation of carbon monoxide at high temperatures and the effect of temperature on the rate of formation and the composition of water gas. Indicates how the results of the tests apply to the operation of boiler furnaces and gas producers.

Bulletin 8. The flow of Heat Through Furnace Walls. 5 cents. Describes experiments that show that a furnace wall with an air space offers less resistance to heat flow than a solid wall of the same thickness. Discusses the laws of heat transmission.

Bulletin 9. Recent Development of the Producer-Gas Power Plant in the United States. 15 cents. Discusses the opinions of owners and manufacturers on the efficiency of such plants and gives a list of installations in the United States.

Bulletin 11. The Purchase of Coal by the Government under Specifications, with Analyses of Coal Delivered for the Fiscal Year 1908-9. 10 cents. Describes the Government's plan of purchasing coal under specifications and the methods of sampling and testing: gives the form of specification used and many analyses of coals.

Bulletin 21. The Significance of Drafts in Steam-Boiler Practice. 10 cents. Discusses the factors that govern the flow of air through fuel beds and boilers, and the capacity of boilers. Written for the information of power-plant engineers and designers of boilers.

Bulletin 22. Analyses of Coals in the United States, with Descriptions of Mine and Field Samples Collected. 85 cents. Describes methods of collecting and analyzing samples of coal which were taken from over 1500 mines and prospects in different parts of the United States. Heating values of all the coals are given and both proximate and ultimate analyses of a large proportion of the samples.

Bulletin 23. Steaming Tests of Coals and Related Investigations, September 1, 1904, to December 31, 1908. 50 cents. A comprehensive summary of tests at the Government fuel-testing plants at St. Louis, Mo., and Norfolk, Va. Is especially intended for mechanical engineers, designers of boiler plants, and persons interested in the efficient utilization of coal under boilers. Summarizes the results of 551 steaming tests with a wide variety of coals and several different types of boilers. Among the subjects discussed are the efficiencies of furnaces and boilers, and the relation of combustion, composition of the products of combustion, air supply, combustion of coal, the results of the tests, and the principles involved in the combustion of coal in boiler furnaces.

Bulletin 37. Comparative Tests of Run-of-Mine and Briquetted Coal on Locomotives, Including Torpedo-Boat Tests, and Some Foreign Specifications for Briquetted Fuel. 15 cents. Discusses the use of briquets in Germany, Belgium, and France, and gives the results of some tests of a Pennsylvania bituminous coal.

Bulletin 38. The Origin of Coal, by David White and Reinhardt Thiessen, with a chapter on the Formation of Peat. 80 cents. Discusses the geologic relations of the different coals, and the effects of physiographic conditions, rate of deposition, and regional metamorphism, the origin and formation of peat, and the constitution of coal as determined by microscopic study.

Bulletin 41. Government Coal Purchases under Specifications, with Analyses for the Fiscal Year, 1909-10. 15 cents. Discusses the value of coal as fuel, the advantages of definite specifications for purchasing coal, and the Government as a coal purchaser. Gives heating value of a large number of coals used at Government power plants, and the proximate analyses of most of these coals.

Bulletin 43. Comparative Fuel Values of Gasoline and Denatured Alcohol in Internal-Combustion Engines. 20 cents. A detailed statement of the results of 2000 tests made to determine the comparative value of the two fuels for use in internal-combustion engines. Is a technical report, written for mechanical engineers and persons interested in the utilization of liquid fuels.

The following publications are still available for free distribution by the Bureau of Mines, Washington, D. C.

Bulletin 1. The Volatile Matter of Coal. Discusses briefly the composition of the volatile matter of several typical American coals and the amount given off at different temperatures.

Bulletin 2. North Dakota Lignite as a Fuel for Power-Plant Boilers. Gives results of steaming tests at Williston, N. Dak., in a boiler plant having furnaces of special design. Of interest to mechanical engineers and to users of lignite.

Bulletin 4. Features of Producer-Gas Power-Plant Development in Europe. Briefly summarizes some features of gas-producer practice, with particular reference to the use of low-grade fuels.

Bulletin 5. Washing and Coking Tests of Coal at the Fuel-Testing Plant, Denver, Colo. Describes methods and results. Most of the coals tested were from coal fields in the Rocky Mountain province.

Bulletin 12. Apparatus and Methods for the Sampling and Analysis of Furnace Gases. Describes methods of taking "continuous" and "instantaneous" samples and the special apparatus designed for such sampling.

Bulletin 13. Resume of Producer-Gas Investigations. Summarizes the results of producer-gas investigations at the Government fuel-testing plants. Incidentally discusses gas-producer development in this country and in Europe. Is intended especially for mechanical engineers and power-plant officials interested in gas-producer design and in the operation of gas producers on the coals available at different points in the United States.

Bulletin 14. Briquetting Tests of Lignite at Pittsburgh, Pa., 1908-9, with a chapter on Sulphite-Pitch Binder. Describes the lignites tested and the briquetting plant, gives results of the tests, and presents a statement of the probable cost of briquetting lignite on a commercial scale.

Bulletin 16. The Uses of Peat for Fuel and Other Purposes. Summarizes recent developments in the utilization of peat. Treats of the origin and formation of peat, its fuel value, and the manufacture of peat fuel. Also discusses progress in utilizing peat for other purposes.

Bulletin 18. The Transmission of Heat into Steam Boilers. A technical discussion of the factors affecting the capacity and efficiency of steam boilers. Presents the results of numerous tests, and a mathematical treatment of the theory of heat transmission through boiler tubes.

Bulletin 27. Tests of Coal and Briquets as Fuel for House-Heating Boilers. Gives the results of tests and presents data for determining the relative value of fuels for use in house-heating boilers. Reprint of United States Geological Survey Bulletin 366.

Bulletin 28. Experimental Work Conducted in the Chemical Laboratory of the United States Fuel-Testing Plant at St. Louis, Mo. Discusses factors affecting the accuracy of the analyses of coal by the methods used at the fuel-testing plant in St. Louis.

Bulletin 29. The Effect of Oxygen in Coal. Compares the composition, especially the oxygen content, of a large number of coals in its relation to the calorific value of a given coal. Discusses the causes of the variation in oxygen content and the relation of the original constituents of a coal to coking properties. Is intended for chemists, geologists, and fuel engineers.

Bulletin 31. Incidental Problems in Gas-Producer Tests. Considers the factors affecting the proper length of gas-producer tests and the differences in temperature at different points in the fuel bed.

Bulletin 32. Commercial Deductions from Comparisons of Gasoline and Alcohol Tests on Internal-Combustion Engines. Summarizes deductions based on 2000 comparative tests of gasoline and alcohol.

Bulletin 33. Comparative Tests of Run-of-Mine and Briquetted Coal on the Torpedo Boat *Biddle*. Describes the tests. Calls attention to the importance of large combustion space in burning smoky coals.

Bulletin 34. Tests of Run-of-Mine and Briquetted Coal in a Locomotive Boiler. Describes the tests. Gives suggestions as to possible methods of increasing the capacity of locomotive boilers.

Bulletin 35. The Utilization of Fuel in Locomotive Practice. Presents the results of tests bearing on the heat lost and utilized from the fuel burned. Gives some general conclusions as to the probable economies to be effected.

Bulletin 39. The Smoke Problem at Boiler Plants, a Preliminary Report. Discusses conditions at boiler plants in the United States, the smoke ordinances of various cities, the factors that cause smoke, and the methods of smoke abatement.

Bulletin 40. The Smokeless Combustion of Coal in Boiler Furnaces, with a chapter on Central Heating Plants. Describes results of an investigation of a large number of boiler plants in different cities. Gives details of the furnaces and boilers used at these plants and the methods of firing.

Bulletin 49. City Smoke Ordinances and Smoke Abatement. Mentions the factors affecting smoke abatement in cities, and summarizes the salient features of the smoke ordinances of 28 cities in the United States. Presents form of ordinance suggested for large city or small city.

Bulletin 55. The Commercial Trend of the Producer-Gas Power Plant. A discussion of the present status of the producer-gas power plant, with views of manufacturers and of owners and operators of producer-gas power plants. The numbers and distribution of producer-gas power plants in the United States are shown.

Bulletin 58. Fuel-Briquetting Investigations. Summarizes the fuel-briquetting investigations conducted by the Government within the period indicated.

Bulletin 88. The Condensation of Gasoline from Natural Gas. Describes the growth of the industry. Discusses methods of condensation, transportation, and blending with reference to lessening waste of gas.

Technical Paper 3. Specifications for the Purchase of Fuel Oil for the Government, with Directions for Sampling Oil and Natural Gas. Gives the specifications prepared by the Bureau of Mines and the methods of sampling used by the bureau.

A GENERATOR VALVE will often work better when opening downward. It is not always convenient to connect it up this way, but it can be so arranged in many installations.—The Gas Engine.

Overhauling the Refrigerating Plant

HINTS TO ELIMINATE MUCH UNNECESSARY LABOR AND EXPENSE. BY A. G. SOLOMON

IN overhauling a refrigerating or any other plant, the very first thing to do is to lay out the work to be done. If the daily report sheets have been properly attended to, the principal points will all be noted and the material to be used ordered, and the changes to be made will all be figured out beforehand. But these report sheets will not necessarily contain facts on what may be termed the general overhauling such as must be given the plant whether any changes are to be made or any new apparatus added. The overhauling, as it is commonly understood, consists of a thorough inspection, cleaning and repairing of the equipment in use.

The boiler room of a refrigerating plant is the same as the boiler room of any other plant and need not be touched on in this article.

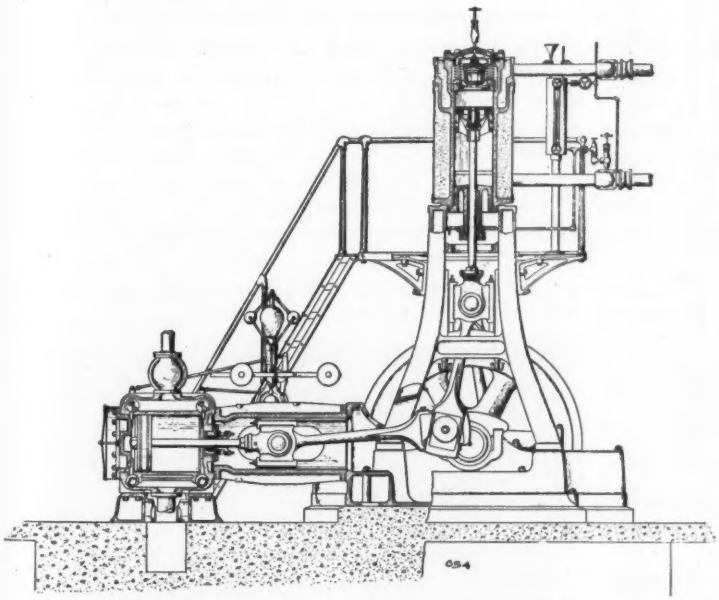


FIG. 1. CROSS-SECTIONAL VIEW OF REFRIGERATING UNIT

If the refrigerating machine is steam driven, the engine part will be given the general overhauling such as any steam engine receives. If motor drive is used, the motor and belt must be given the attention such apparatus demands.

The refrigerating plant consists of the ammonia compressor, ammonia condensers, evaporating coils, which are either direct expansion piping or coils in the brine tank or some type of brine cooler, oil separator, liquid receiver and the necessary pipe work.

First to be considered will be the ammonia compressor, which is really nothing more or less than a strong and well constructed pump cylinder. In principle of operation, it is the same as the ordinary air pump. It takes the ammonia gas from the evaporating coils at a low pressure and discharges into the condenser at a higher pressure.

Leakage through the valves and by the plunger packing of a pump is well known to be a direct loss and therefore a waste of power. But the leakage in an ammonia cylinder is even more important. Even small leaks must be avoided and this is done by attention to the compressor valves and piston rings. Some compressors are so constructed that there is a gasket between the cylinder and the suction and discharge ports. Where such is the case the greatest care must be exercised to prevent leakage at that point.

UPRIGHT SINGLE-ACTING COMPRESSORS

IF THE ice machine to be overhauled is of the upright single-acting type and the service must not be entirely stopped for a great length of time, the first thing to

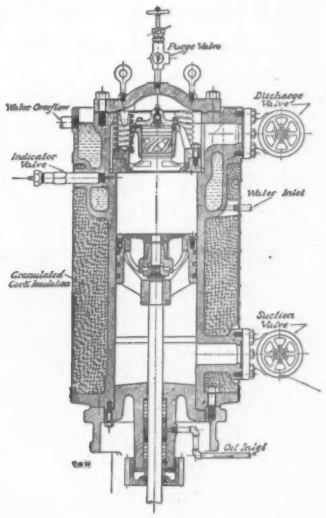


FIG. 3. DETAILS AND SECTIONAL VIEW OF COMPRESSOR

be done is to pump out one of the 2 cylinders and take down the side connecting rod. First expel the ammonia by closing the suction and discharge stop valves next to the cylinder and use the bypass connections provided for the purpose. When doing this, look over the pipe work carefully and be positive that the proper valves are open so that there is an outlet for the gas. Failure to provide this outlet may result in a blown-out gasket and probably a ruptured fitting or even a wrecked cylinder.

After the cylinder has been pumped out and the rod taken down the machine can be started and run one sided. By increasing the speed a little and operating a few hours more than formerly the load can be carried.

Before taking off the cylinder head or disconnecting any flanges, open the purge valve and see that the ammonia has been entirely expelled. There should be a

slight vacuum; but this may not be the case, owing to the presence of ammonia-charged oil in the cylinder or valve chambers. Leave the purge valve open for a few minutes. If ammonia still continues to escape, the cause will most likely be found to be a leaky valve. This must be located and, if it cannot be shut tight or repaired right at the time, the flange between it and the cylinder should be disconnected and a blind gasket made of light sheet iron inserted. This will answer the purpose very well and will prevent the escape of ammonia while the compressor is open.

In this connection, it is well to say that all leaky valves should have been located and noted and if possible should have been repaired before the overhauling

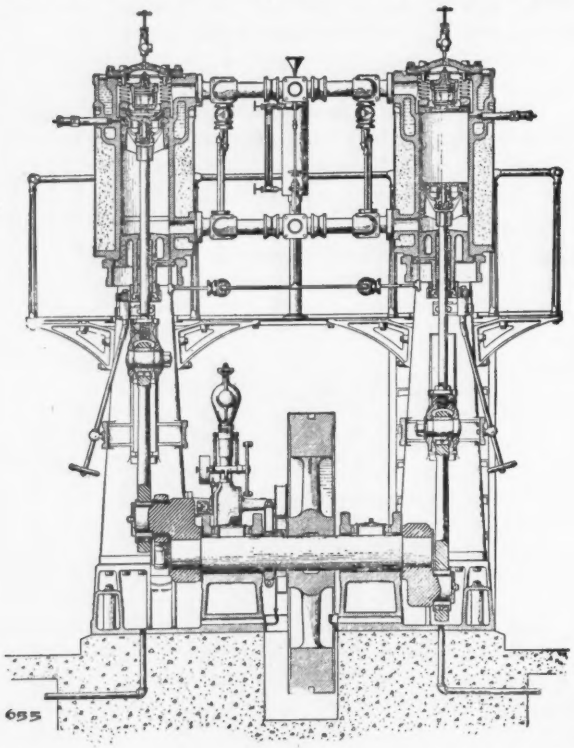


FIG. 2. SECTIONAL VIEW OF REFRIGERATING UNIT PARALLEL TO SHAFT

itself is actually begun; but in most places, the leaking valves are not known until parts of the system are opened up. Blind gaskets will do very well; but do not fail to make a note that the valve leaks.

After the ammonia leakage is all stopped, the compressor head is lifted off and the valves and piston removed. Tram the rod as to its position in the crosshead before unscrewing. I have found the best method of tramming is to fix upon a certain distance, say 4 or 6 in., and by using a pair of dividers use this same tramming distance for all the work. Mark distinctly with a small pointed center punch. Do not put any marks on the rod in a place where they will enter the stuffing-box.

Before unscrewing the rod, the packing must be taken out. Do not save this packing unless it is in extra good condition, for the use of poor packing will cause more trouble than it is worth. Later in this article will be shown a use for this old packing in a temporary manner.

The condition of the cylinder can be seen almost at a glance. There is scarcely any chance in the world of an upright ammonia cylinder being worn out of round; so if there are no cuts or score marks, the cylinder is O. K. If there are any cuts, the cylinder should be bored out. When we realize what a difference in pressure between the suction and discharge the compressor is pumping, it is seen that even small cuts must not be neglected. Boring a cylinder and fitting a new piston will be found much cheaper than running through a season with ammonia gas blowing by the piston.

Next, the piston and rings are examined. Cast-iron snap rings are the kind usually found in this style of machine. See that they fit properly in the grooves. They must be just loose enough to be easily turned, but not so loose that ammonia gas can leak past by passing around and under the ring. The edges of the rings will be found almost razor sharp and should be carefully rounded off with a smooth file, as the sharp edges will scrape the lubricant off the cylinder walls and this may cause friction, wear and cutting.

The suction valve, which is in the piston, must be taken out, and if there are any pit marks caused by the passage of scale, the seat must be carefully ground in with emery and oil. All the valves of an ammonia compressor should be gasoline tight after grinding; that is, gasoline should not leak through. Examine the spring for wear and for tension. This suction valve spring should be just strong enough to hold the weight of the valve; more tension will cause pounding and restricted passage for the ammonia.

When assembling again, the greatest care must be taken to see that the nuts on the valve stem are set up tight and the pin through the lock nut and stem is a snug fit and the ends riveted over. Neglect of this may cause a serious accident as the valve may come loose and get between the piston and compressor head.

Screws holding the suction valve cage in place in the piston must be tightly set up and if any of them fit even slightly loose in the threads, they must be replaced with others which are new and tight fitting. These screws backing out are not liable to cause any damage but it will mean the opening up of the cylinder at a time when the machine cannot be spared.

Next comes the discharge valve and false or safety head. This false head is not meant to be used as a discharge valve as is too often found to be the case. It is there for safety, only, in case the compressor gets a heavy slug of liquid or anything breaks and gets into the cylinder.

If any cuts (even if they look like pin scratches) are found on the seating surface of the false head fine emery and oil must be used. Make this joint just as tight as possible, for leakage here is just the same as leakage through the discharge valve.

The discharge valve, which is in the false head, is given the same general treatment as the suction valve and tested with gasoline.

The gasket between the cylinder and cylinder head need not be renewed if it has not been disturbed or showed signs of leaking. It is a male and female joint and a lead gasket being used there is seldom any trouble with it.

Crank, crosshead and guide bearings must receive the same attention as those on a steam engine.

Now that all the parts are ready, the compressor is put together again and the side connecting rod put in place. Adjust the length of the piston rod to the tram marks, then turn the machine over by hand until the crosshead is at its highest point. Then unscrew the rod from the crosshead until the piston comes in contact with the top cylinder head. With everything keyed up properly and the rod cold the clearance should be between 1/32 and 1/16 in., depending on the size of the machine and the temperature at which the rod runs when operated under ordinary conditions.

The packing of the stuffing-box must be done carefully and none but the very best packing should be used. If this machine is to be used for pumping an air pressure, for blowing out coils and for testing, some cheaper grade of packing can be used temporarily. Or the old packing which was taken out can be used during this time. Using the machine as an air compressor may be the means of ruining the high priced ammonia packing and rather than take a chance the cheaper or old packing can be used while the plant is being overhauled and tested out.

The other ammonia compressor of the machine is gone through in the same manner as described and in this way the overhauling is accomplished without a long interruption of service. Of course, in some plants the compressor is the last thing to be overhauled; but whether first or last, the work to be done is the same. Where the weather gets extremely cold in the winter it is a very good plan to overhaul the ammonia condensers and other outside apparatus just as early in the winter season as the load will permit.

Drilling a Well Under Difficulties

DESCRIPTION OF HOMEMADE WELL DRILLING MACHINERY AND METHOD OF DRILLING WELL IN BASEMENT. BY FRED H. WITTERS

IN a city where the city water is entirely unfit for drinking and cooking purposes, being pumped from the river, which is fed by several small and sluggish streams, and containing a great deal of sediment and other objectionable material, the residents have found it necessary to use wells for the supply of good water. Some surface wells are used, but the best supply of water is obtained from drilled wells varying in depth from 100 to 200 ft. These are drilled to the water bearing rock where a good supply is found unless the drilling is carried too far, when salty water is the result.

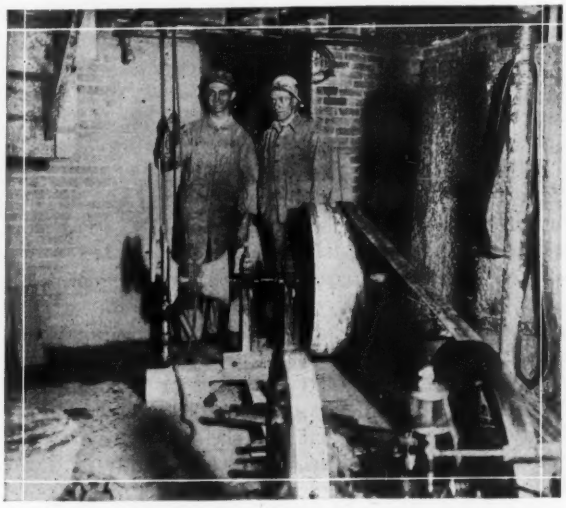


FIG. 1. MACHINE CONTRIVED FOR DRILLING WELL IN BASEMENT

Several wells have been drilled on street corners by subscription for public use. Not living within a block of one of these wells, I got the idea of building a machine with which I could drill a well in my basement. Figure 1 shows the machine, constructed mostly of old material found around a plant using power machinery, such as shafting, hangers, pulleys, etc.

On one end of a heavy oak plank (4 by 12 in. by 12 ft.) was bolted a pair of hangers and on one end of the shaft through them was a 32-in. pulley. On the other end was a hoisting spool which had outlived its usefulness on the gypsy winch of an old tug. On the outer end of the spool was bolted an arm, with a pin at the outer end of that on which was a flanged wheel. This wheel had a throw of about 14 in.

On the other end of the plank was the gasoline engine which furnished the power, being belted to the pulley on the shaft.

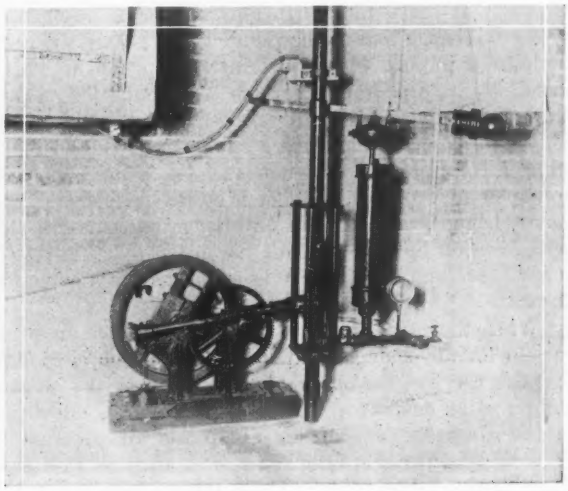


FIG. 2. PUMP HEAD INSTALLED IN BASEMENT

Two pulley blocks were hung from the ceiling, one directly over where the well was to be and one about 2 ft. toward the engine and in a line with the flanged wheel. The idea of the flanged wheel was to take up and let out slack in the rope between the ceiling block pulleys, thus giving an up and down motion at the well, the other being fastened to a cleat. This was paid out a little at a time as the drilling progressed.

XUM

With such small head room the job was somewhat difficult as everything going into the well had to be in sections not over 6 ft. long. The drill rod was made of 3 pieces of extra heavy 1-in. pipe, on one end of which was screwed a tool steel drill bit and on the other end an improvised slip. This slip made it possible when the drill got stuck several times to give an upward blow and loosen it. The casing consisted of 6-ft. lengths of 2-in. galvanized pipe.

After drilling a few feet, it would be necessary to bail out the hole and for this a small sand pump was used. This was lowered and filled and then raised by means of the hoisting spool, to be emptied. The spool was also used to raise an iron block which was the hammer for driving casing.

At 50 ft., a boulder was struck which had to be dynamited; at 60 ft., the rope broke at the drill and the drill had to be fished out with short pipes screwed together to make that length; at 75 ft., a layer of quicksand was struck which gave considerable trouble until finally the casing reached the rock at 102 ft. The hole was drilled into the rock about 4 ft., and the casing driven a little way into the rock to seal out all sand and loose dirt. At this depth the supply of water was good, both in quality and quantity.

It was then necessary to arrange a way of pumping the water. As the level of the water in the well was 55 ft. from the surface, the working barrel was lowered on 11 6-ft. lengths of 1-in. pipe with pump rods inside. Figure 2 shows the arrangement of the pump head which was made of 2 rectangles of boiler plate and 4 pieces of 1-in. pipe 22 in. long with bolts through them and the plates, the pipes acting as spreaders. The pump jack is driven by a ½-hp. motor.

As I wanted to pump directly to the kitchen, it was necessary to make the starting of the motor automatic. In the discharge line of the pump I had an air chamber made of a piece of 4-in. pipe in the top cap of which was a ½-in. pipe tap. To this was connected a diaphragm regulator such as is used on steam heating boilers to close the dampers. The lever from the regulator is connected to a switch such as is used to close and open a circuit when a door is closed or opened. The motor, being small and run on alternating current, can be thrown on the line without the use of starting resistance; therefore, this switch is connected in the motor circuit.

When the pump is started it runs until the air pressure in the air chamber and on the diaphragm is enough to raise the weights on the lever and open the switch, stopping the motor. When a valve is opened anywhere in the discharge line of the pump the air pressure is decreased on the diaphragm, the weights pull the lever down, closing the switch. The motor runs until the valve is closed, when the air pressure is raised again, which raises the weights and opens the switch.

The supply is being used in 2 houses, a hole having been bored from basement to basement through which it is piped. Opening the faucet in either kitchen automatically starts the pump.

"Beware of being sidetracked. Petty spite, jealousy and personal antagonism may rile you almost to the breaking point, but don't be diverted."

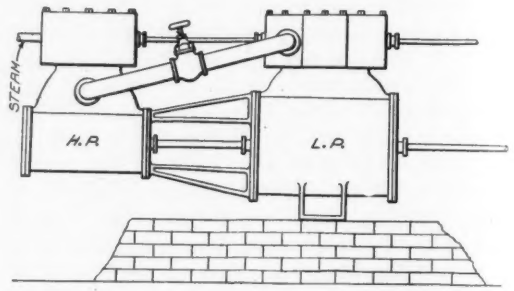
Running a Duplex Pump with One Plunger

Broken Piston Rod Forces Engineer to Devise Means to Continue Pump in Operation. By T. J. Rogers

A DUPLEX pump in good working order may be compared to a man with 2 good legs. As long as a man's legs are in good condition, he is able to move about from place to place, but let one of them become disabled, as by being broken or paralyzed, and the man is helpless until he is supplied with a crutch or cane to lean upon.

When both sides of a duplex pump are in good working order there is no trouble and the pump runs along smoothly and quietly, requiring little attention; but let any part of either side become disabled and the pump is useless until the broken part is repaired.

I wish to relate how I managed to make a duplex pump run and supply all the water required for a large plant, during a period of 3 weeks' time, with but one water plunger, the other one having become disabled by



GLOBE VALVE PLACED IN HIGH-PRESSURE EXHAUST LINE USED TO CHOKE EXHAUST ON DISABLED SIDE

the piston rod breaking square off at the end of the taper where it entered the hub of the plunger. The plant in question consisted of 10 boilers, together with engines of various sizes, the largest being 600 hp. The pump referred to was a duplex, compound condensing, having a capacity of 2,500,000 gal, in 24 hr. It was connected so that in case of fire, high-pressure steam could be turned directly into the low-pressure cylinders, thus enabling the pump to work against the high water pressure required for fire service. It was also connected so that it could be run condensing or noncondensing. This machine supplied all the water used throughout the works, including that for the boilers, and it will be readily seen that should anything occur to disable the pump the works would be at a standstill.

This was just the predicament the author found himself in one day when suddenly one of the piston rods broke, as stated, where it entered the plunger. I should also state that the water end of this pump was of the plunger and ring type. Not having an extra rod on hand, I simply took the plunger out of the water end, put the water cylinder head back on again and commenced to do a little figuring.

It is well known that in a duplex pump the motion of the piston rod on one side is utilized to move the

steam valves of the other side, and vice versa. Now, so long as we have the resistance of the water against the plunger, the motion will be slow and even, and in perfect accord with the other side; but in this case, as there was nothing but the broken end of the piston rod to move against the pressure of the water, there was practically no resistance, consequently the disabled side would move with quick jerks and would not impart the proper motion to the steam valves of the other side. The problem was to get the piston rod of the disabled side to move slowly enough—in fact, at the same speed required by the other side in order to pump water.

Now, there are 2 ways by which this can be done, first by throttling the steam admitted to the disabled side, secondly by choking the exhaust. As this pump was fitted with globe valves in both steam and exhaust branches, for the purpose of changing from compound to simple and from condensing to noncondensing, I chose the second plan and found that by choking the exhaust down to the proper point on the disabled side, I could get that side to move at the required speed.

The pump started off and ran all right, supplying with one plunger, all the water needed. This was continued for about 3 weeks, or until I got a new rod and was ready to put it in.

The accompanying sketch show the valve in the exhaust from high to low pressure, which was utilized for the purpose.

In a simple duplex pump it might not be possible to choke the exhaust, but it would be possible to place a stop valve in each branch of the live steam inlet and thus have the means at hand for operating one side of the pump in case of a breakdown.

Of course, in the smaller sizes of duplex pumps this could not be done, but it might be possible, in case one of the water pistons becoming disabled, to moderate the speed of the broken side either by screwing up the packing glands on the rod, thereby causing friction enough to create the necessary resistance, or by taking the packing rings out of the steam piston and allow the steam to blow past, or both plans could be tried at the same time.

I merely offer these suggestions for the benefit of engineers who are running steam plants in localities where it requires considerable time to get duplicate parts of pumps from the factory, or who, on the other hand, may have the duplicate part but who, when the break-down occurs, due to certain existing conditions, cannot stop long enough to install the new part.

PROGRESS IS BEING MADE in bringing agreement between the Massachusetts boiler code and that of the A. S. M. E. The Massachusetts Board of Boiler Rules is friendly, but does not deem it advisable to permit 2 standards in the state. As there are now only small differences and a desire to get together, it is hoped that these differences may soon be removed.

The American Society of Mechanical Engineers has ordered a second printing of the Code with some typographical errors corrected, some points settled where there have arisen questions of interpretation of the rules, and with a complete index which will enable quick and ready reference to any point.

Water Indicator Diagrams

TYPICAL DIAGRAMS AND COMMENTS ON CONDITIONS UNDER WHICH THEY WERE TAKEN. BY W. O. WILSON

THE accompanying cards are samples of what may be obtained in this line from different styles of pumps and of how conditions may influence the various lines of diagrams.

Card No. 6 is from an outside center packed plunger pump of 7,000,000 gal. daily capacity, taking suction from an open well to which water is supplied from a large river through a tunnel of ample size to insure the water level in the well remaining at the same elevation as that of the river which is practically uniform throughout the year. This pump delivers water into an open reservoir through about a mile and a quarter length of discharge piping and is equipped with 4 large air domes or chambers, one over each discharge valve deck, besides an abnormally large air chamber on the main discharge line about 50 ft. from the pump. A large vacuum chamber is also installed in the suction line directly over the cross suction pipe leading to the suction chamber.

Set No. 4 was taken from a 4,000,000-gal. pump of the same design, taking suction from a large open well into which numerous artesian wells siphon. This pump has the same equipment, in regard to vacuum and air chambers, except that a large air chamber on the discharge main is located close to the pump, and the delivery is to a standpipe.

Set No. 2 is from a 5,000,000-gal. pump of the plunger and ring type, taking suction from an open well into which driven wells siphon. It has 2 large air chambers on the discharge line just as it leaves the pump, but has no vacuum chamber. It works on direct service; that is, discharges into closed mains, the rate of water consumption of the city controlling the speed by means of a pressure regulated governor acting on the high-pressure cutoffs, thus maintaining a constant pressure in the discharge mains.

These 3 sets represent a close approach to the ideal water diagram.

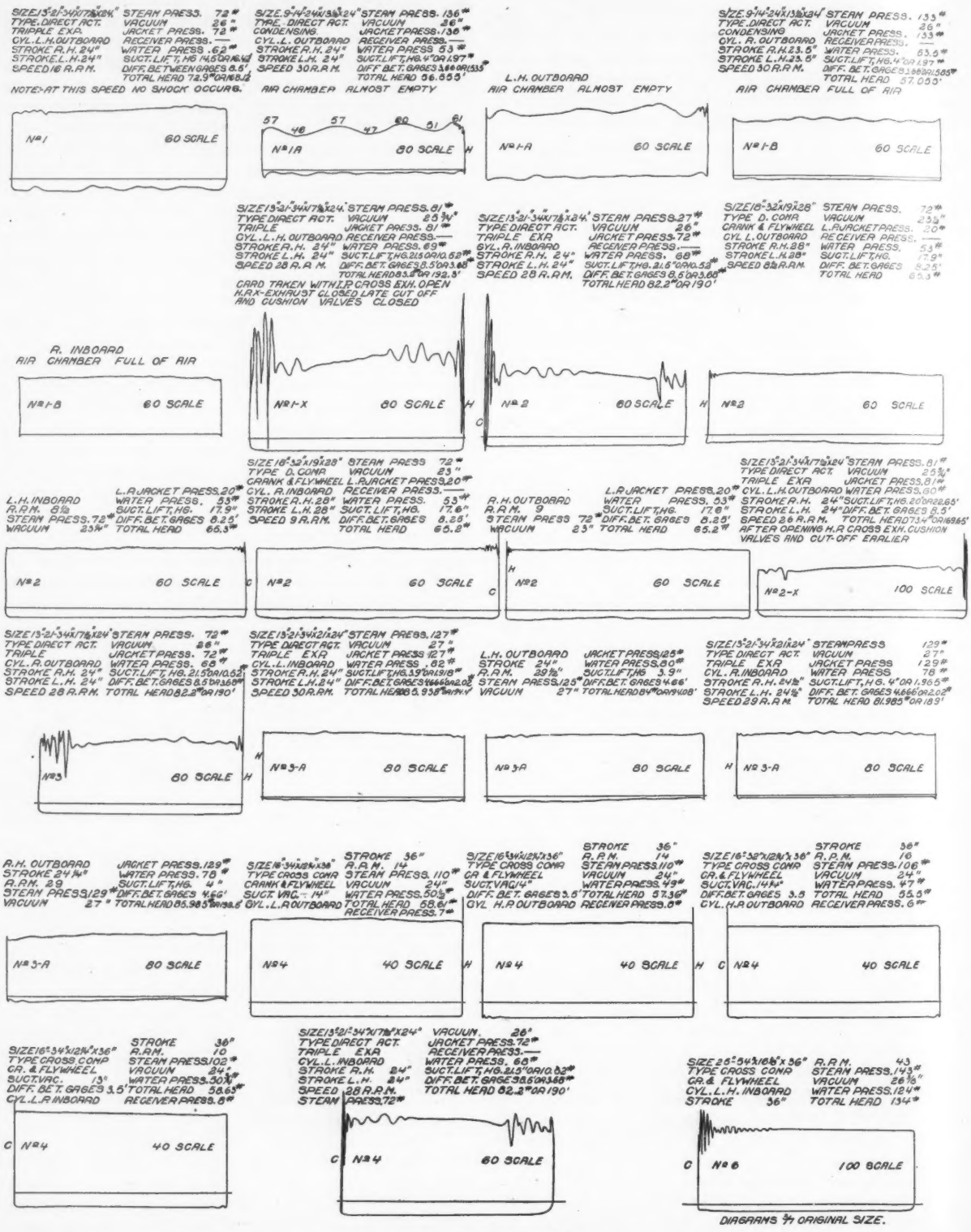
Set No. 1-A and set No. 1-B are from a 2,500,000-gal., direct-acting triple of the plunger and ring type, taking suction from an open reservoir and working on standpipe service.

This pump has a vacuum chamber on the cross suction pipe at the pump and an air chamber on the discharge line just as it leaves the pump. This air chamber is referred to by the notes on the cards which explain the cause of the difference in discharge lines.

Sets No. 1, 2, 3 and 4 are from a 4,000,000-gal., direct-acting, outside center packed triple, taking suction from an open well which is supplied by several driven wells. It discharges into closed mains, and a constant pressure is maintained in the system by means of a pressure regulated throttling governor. An air chamber is located on the discharge line just as it leaves the pump, but there is no vacuum chamber on the suction line.

These cards indicate, very plainly, the presence of air, also that severe shocks were present through the water-end. This condition arises from the fact that the pump, when running at this speed, taxes the capacity of the flowing wells to the extent of lowering the water in the main well until the suction lift increases to

nearly 25 ft. and considerable air is drawn, by swirls and eddies, into the suction pipe with the water, as at this lift the end of the suction pipe is not sufficiently submerged to prevent this. Obviously, the thing to do would be to drill more wells; but, as it was not considered expedient to do so at this time, a smooth running pump was obtained by installing a vacuum chamber on the suction line close to the pump and a pipe connection from the top of this chamber to the suction of the vacuum pump.


SIZE 13"-21"-34"X17⅞"X24" STEAM PRESS. 72#
TYPE. DIRECT ACT. VACUUM 26"
TRIPPLE EXP. JACKET PRESS. 72#
CYL. L.H. OUTBOARD RECEIVER PRESS. —
STROKE R.H. 24" WATER PRESS. 62#
STROKE L.H. 24" SUCT. LIFT, HG. 14.5 OR 16.4'
SPEED 16 R.P.M. DIFF. BETWEEN GAGES 8.5'
TOTAL HEAD 72.9# OR 168.2'
NOTE:-AT THIS SPEED NO SHOCK OCCURS.
N°1 60 SCALE
SIZE 9"-14"-24"X13⅜"X24" STEAM PRESS. 136#
TYPE. DIRECT ACT. VACUUM 26"
CONDENSING JACKET PRESS. 136#
CYL. L. OUTBOARD RECEIVER PRESS. —
STROKE R.H. 24" WATER PRESS 53.3#
STROKE L.H. 24" SUCT. LIFT, HG. 4" OR 1.97"
SPEED 30 R.P.M. DIFF. BET. GAGES 3.66 OR 1.535'
TOTAL HEAD 56.655'
AIR CHAMBER ALMOST EMPTY
57 46 57 47 60 51 61
N°1-A 60 SCALE
L.H. OUTBOARD
AIR CHAMBER ALMOST EMPTY
N°1-A 60 SCALE
SIZE 9"-14"-24"X13⅜"X24" STEAM PRESS. 133#
TYPE. DIRECT ACT. VACUUM 26"
CONDENSING JACKET PRESS. 133#
CYL. R. OUTBOARD RECEIVER PRESS. —
STROKE R.H. 23.5" WATER PRESS. 63.9#
STROKE L.H. 23.5" SUCT. LIFT, HG. 4" OR 1.97"
SPEED 30 R.P.M. DIFF. BET. GAGES 3.3663 OR 1.585"
TOTAL HEAD 57.055'
AIR CHAMBER FULL OF AIR
N°1-B 60 SCALE
SIZE 13"-21"-34"X17⅞"X24" STEAM PRESS. 81#
TYPE DIRECT ACT. VACUUM 25¾"
TRIPLE JACKET PRESS. 81#
CYL. L.H. OUTBOARD RECEIVER PRESS. —
STROKE R.H. 24" WATER PRESS. 69#
STROKE L.H. 24" SUCT. LIFT, HG. 21.5 OR 10.52#
SPEED 28 R.P.M. DIFF. BET. GAGES 8.5 OR 3.68
TOTAL HEAD 83.3# OR 192.3'
CARD TAKEN WITH I.P. CROSS EXH. OPEN H.P. X-EXHAUST CLOSED LATE CUT OFF AND CUSHION VALVES CLOSED
R. INBOARD
AIR CHAMBER FULL OF AIR
N°1-B 60 SCALE
N°1-X 60 SCALE
SIZE 13"-21"-34"X17⅞"X24" STEAM PRESS. 27#
TYPE DIRECT ACT. VACUUM 26"
TRIPLE EXP. JACKET PRESS. 72#
CYL. R. INBOARD RECEIVER PRESS. —
STROKE R.H. 24" WATER PRESS. 68#
STROKE L.H. 24" SUCT. LIFT, HG. 21.5" OR 10.52#
SPEED 28 R.P.M. DIFF. BET. GAGES 8.5 OR 3.68#
TOTAL HEAD 82.2# OR 190'
N°2 60 SCALE
SIZE 16"-32"X19"X28" STEAM PRESS. 72#
TYPE D. COMP. VACUUM 23½"
CRANK & FLYWHEEL L.P. JACKET PRESS. 20#
CYL L. OUTBOARD RECEIVER PRESS. —
STROKE R.H. 28" WATER PRESS. 53#
STROKE L.H. 28" SUCT. LIFT, HG. 17.9"
SPEED 88 R.P.M. DIFF. BET. GAGES 8.25'
TOTAL HEAD 65.3#
N°2 60 SCALE
L.H. INBOARD
R.P.M. 81/2
STEAM PRESS. 72#
VACUUM 23¾"
L.P. JACKET PRESS. 20#
WATER PRESS. 53#
SUCT. LIFT, HG. 17.9"
DIFF. BET. GAGES 8.25'
TOTAL HEAD 65.3#
N°2 60 SCALE
SIZE 16"-32"X19"X28" STEAM PRESS 72#
TYPE D. COMP. VACUUM 23"
CRANK & FLYWHEEL L.P. JACKET PRESS 3.20#
CYL. R. INBOARD RECEIVER PRESS. —
STROKE R.H. 28" WATER PRESS. 53#
STROKE L.H. 28" SUCT. LIFT, HG. 17.6"
SPEED 9 R.P.M. DIFF. BET. GAGES 8.25'
TOTAL HEAD 65.2#
R.H. OUTBOARD
R.P.M. 9
STEAM PRESS 72#
VACUUM 23"
L.P. JACKET PRESS. 20#
WATER PRESS. 53#
SUCT. LIFT, HG. 17.6"
DIFF. BET. GAGES 8.25'
TOTAL HEAD 65.2#
N°2 60 SCALE
N°2-X 100 SCALE
SIZE 13"-21"-34"X17⅞"X24" STEAM PRESS. 81#
TYPE DIRECT ACT. VACUUM 25¾"
TRIPLE EXP. JACKET PRESS. 81#
CYL. L.H. OUTBOARD WATER PRESS. 60#
STROKE R.H. 24" SUCT. LIFT, HG. 20" OR 22.65'
STROKE L.H. 24" DIFF. BET. GAGES 8.5'
SPEED 26 R.P.M. TOTAL HEAD 73.4# OR 169.5'
AFTER OPENING H.P. CROSS EXH. CUSHION VALVES AND CUT-OFF EARLIER
SIZE 13"-21"-34"X17⅞"X24" STEAM PRESS. 72#
TYPE DIRECT ACT. VACUUM 26"
TRIPLE JACKET PRESS. 72#
CYL. R. OUTBOARD WATER PRESS. 69#
STROKE R.H. 24" SUCT. LIFT, HG. 21.5 OR 10.52#
STROKE L.H. 24" DIFF. BET. GAGES 8.5 OR 3.68#
SPEED 28 R.P.M. TOTAL HEAD 82.2# OR 190'
N°3 60 SCALE
SIZE 13"-21"-34"X17⅞"X24" STEAM PRESS. 127#
TYPE DIRECT ACT. VACUUM 27"
TRIPLE EXP. JACKET PRESS 127#
CYL. L. INBOARD WATER PRESS. 82#
STROKE R.H. 24" SUCT. LIFT, HG. 3.9" OR 1.8"
STROKE L.H. 24" DIFF. BET. GAGES 4.666 OR 2.02#
SPEED 30 R.P.M. TOTAL HEAD 86.5.938" OR 194.4'
N°3-A 80 SCALE
L.H. OUTBOARD
STROKE 24"
R.P.M. 29
STEAM PRESS 129#
VACUUM 27"
JACKET PRESS 125#
WATER PRESS 80#
SUCT. LIFT, HG 3.9"
DIFF. BET. GAGES 4.66'
TOTAL HEAD 84# OR 194.08'
N°3-A 80 SCALE
SIZE 13"-21"-34"X21"X24" STEAM PRESS 129#
TYPE DIRECT ACT. VACUUM 27"
TRIPLE EXP. JACKET PRESS 129#
CYL. R. INBOARD WATER PRESS 78#
STROKE R.H. 24½" SUCT. LIFT, H G. 4" OR 1.965#
STROKE L.H. 24½" DIFF. BET. GAGES 4.666 OR 2.02#
SPEED 29 R.P.M. TOTAL HEAD 81.985# OR 189'
N°3-A 80 SCALE
R.H. OUTBOARD
STROKE 24¼"
R.P.M. 29
STEAM PRESS 129#
VACUUM 27"
JACKET PRESS 129#
WATER PRESS. 78#
SUCT. LIFT, HG. 4"
DIFF. BET. GAGES 4.66'
TOTAL HEAD 85.985# OR 198.6'
SIZE 16"-34"X28"X36" STROKE 36"
TYPE CROSS COMP R.P.M. 14
CRANK & FLYWHEEL STEAM PRESS. 110#
SUCT. VAC. 14" VACUUM 24"
CYL. L.R OUTBOARD WATER PRESS. 50½#
TOTAL HEAD 58.6#
RECEIVER PRESS. 7#
N°4 40 SCALE
SIZE 16"-34"X28"X36" STROKE 36"
TYPE CROSS COMP R.P.M. 14
GR. & FLYWHEEL STEAM PRESS. 110#
SUCT. VAC. 14" VACUUM 24"
DIFF. BET. GAGES 3.6 WATER PRESS. 49#
CYL. H.P OUTBOARD TOTAL HEAD 57.36#
RECEIVER PRESS. 6#
N°4 40 SCALE
SIZE 16"-32"X28"X36" STROKE 36"
TYPE CROSS COMP R.P.M. 10
GR. & FLYWHEEL STEAM PRESS. 106#
SUCT. VAC. 14¼" VACUUM 24"
DIFF. BET. GAGES 3.6 WATER PRESS. 47#
CYL. H.P OUTBOARD TOTAL HEAD 55.3#
RECEIVER PRESS. 6#
N°4 40 SCALE
SIZE 16"-34"X28"X36" STROKE 36"
TYPE CROSS COMP R.P.M. 10
GR. & FLYWHEEL STEAM PRESS. 102#
SUCT. VAC. 13" VACUUM 24"
DIFF. BET. GAGES 3.6 WATER PRESS. 50½#
CYL. L.R INBOARD TOTAL HEAD 58.65#
RECEIVER PRESS. 8#
N°4 40 SCALE
SIZE 13"-21"-34"X17⅞"X24" VACUUM 26"
TYPE DIRECT ACT. JACKET PRESS. 72#
TRIPLE EXP. RECEIVER PRESS. —
CYL. L. INBOARD WATER PRESS. 69#
STROKE R.H. 24" SUCT. LIFT, HG. 21.5" OR 10.52#
STROKE L.H. 24" DIFF. BET. GAGES 3.8.5 OR 3.68#
SPEED 28 R.P.M. TOTAL HEAD 82.2# OR 190'
STEAM PRESS. 72#
N°4 60 SCALE
SIZE 25"-34"X16⅝"X 36" R.P.M. 43
TYPE CROSS COMP STEAM PRESS. 143#
GR. & FLYWHEEL VACUUM 26⅛"
CYL. L.H. INBOARD WATER PRESS. 124#
STROKE 36" TOTAL HEAD 134#
N°6 100 SCALE
DIAGRAMS 1/4 ORIGINAL SIZE.

WATER INDICATOR DIAGRAMS

The notes on cards No. 1-X and No. 2-X explain why the shock is more severe in one case than the other. The cross exhaust and cushion valves can be manipulated so as to modify or magnify shocks of this nature. The effectiveness of the across exhaust valves differ on some different makes of pumps, due principally to the ratios of steam cylinders employed by the builders.

On this pump it will be noticed that the high pressure across exhaust was the more effective as the shock was greatly reduced by opening this valve which equalized the stroke, but the undesirable feature of the pump slowing down with the resultant drop in discharge pressure indicates that it is more economical to operate with these valves closed.

The cutoff valves on this type of pump afford additional regulation, however, as most compound and simple duplex and even some triple expansion pumps are not equipped with cutoff valves the adjustments must be made with the across exhaust and cushion valves and usually, in the case of a noisy or pounding pump, it is preferable to adjust these valves for quietness even at the sacrifice of economy to a certain degree.

Set No. 3-A is from a 6,000,000-gal., direct-acting triple of the center packed type, working under similar conditions to the 2,500,000-gal. pump, and with the same arrangement of vacuum and air chambers, and represents about as good a card as can be obtained from direct-acting pumps.

House Heating with Less Coal

A PROBLEM which reaches into nearly every home in the United States and touches the pocketbooks of several million householders, is discussed seriously in a report issued by the Bureau of Mines, Department of the Interior, in which the experts of the Bureau tell the public in detail just how, in heating their houses this coming winter, they may save in their coal bills.

The report, issued at a time when the cooler weather is upon the country and people are laying in their winter supply of coal, intimates that large savings can be made in nearly every home and gives specific figures of the results obtained in one home in which every effort was made to consume the coal properly. As the report was issued solely for the benefit of householders, copies may be obtained by anyone who addresses the United States Bureau of Mines, Washington, D. C.

The tests referred to were made in a 10-room house in New Haven, Conn., which was comfortably heated at a cost of $48 for the fall and winter, a saving over other houses of the same size in the same locality of from $50 to $100.

According to Van H. Manning, Director of the Bureau of Mines, similar results can be attained in hundreds of thousands of houses throughout the country with a consequent saving of millions of dollars.

"The report shows not only a low cost of heating," said Mr. Manning, "but also an economical use of fuel and illustrates what savings may be effected when the problem is given proper consideration. Systematic and regular handling of the fire doubtless had considerable to do with the results obtained. The cost of heating is probably $50 to $100 less than what is expended by a large number of householders who live in the same locality and have about the same heating requirements, but use more expensive coal and give their heating equipment less attention.

"The value a householder gets from the fuel he burns depends largely on the character of the heating apparatus, the conditions under which it is installed, and the manner in which the fire is handled. The authors of this report, from their experience in firing residence-heating apparatus and from observing the methods employed by many who attend to such apparatus, keenly appreciate the importance of proper firing methods and they have written this report in the belief that some general remarks on the selection, care, and operation of residence-heating apparatus may prove of some value to many who are interested in burning fuel in the most economical manner."

The authors are L. P. Breckenridge, consulting engineer of the Bureau of Mines and professor mechanical engineering, Sheffield Scientific School, Yale University, and S. B. Flagg, mechanical engineer of the Bureau of Mines.

Among other things, the report states: "Many furnaces and boilers are operated in a haphazard way—drafts are opened or coal is put on when the house becomes cool, then the fire is allowed to burn rapidly until either the rooms are too warm or the fuel bed is burned down too far to kindle properly a new charge of coal.

"Such firing is always wasteful. The heater should receive regular attention, and if the demands for heat are intelligently anticipated, as they ordinarily can be, the house can be warmed with minimum trouble and fuel. When the rooms become too warm, the fire should be checked by stopping the admission of air under the grate and decreasing the draft by opening the 'check damper.' If, as often is done, the ashpit damper or the ashpit door be allowed to remain open and the draft reduced by opening the fire door, the combustion of the fuel continues, although at a slower rate, but the cold air entering the fire door chills the heater so that little heat is realized from the coal.

"To burn a pound of coal requires very much more than a pound of air, and the volume of a pound of air at atmospheric pressure is far greater than that of a pound of coal. To burn more coal requires more air, and this air must be forced into the ashpit and up through the fuel bed by the difference between the pressure of the hot air and gases over the fire pot and that of the air entering the ashpit—in other words, by the 'draft.'"

FOR THOSE who are intrusted with responsibility for the upkeep of automobile trucks, a suggestion is made by the Service Department of the Goodyear Tire & Rubber Co. that is worth consideration.

The driver is the most important factor in the mileage, and a careful driver can save nearly his salary by care of tires. One efficiency engineer gives a record of $10,000 a year saved for a large concern by a system which compelled each driver to take care of his tires. Some of the precautions were: Avoid overloading; drive carefully, especially over rough roads; don't exceed recommended speeds; don't drive in car tracks; don't neglect small cuts.

A bulletin giving the suggestions more in detail can be had from the Goodyear Co.

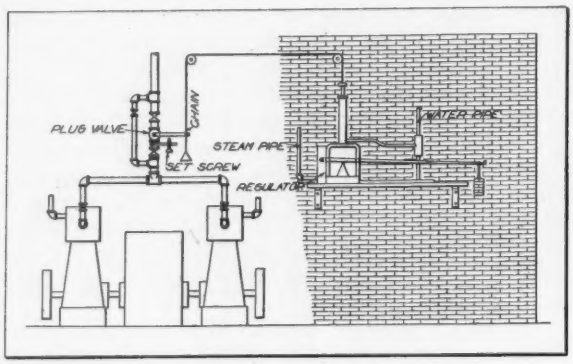
LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Stoker Regulator

THE ACCOMPANYING sketch shows how the speed of the engine which drives the fan and stokers in our plant is controlled. The fan is placed at one end of the boilers, and is connected to the stoker line shaft in the basement through a Diamond link chain drive. On either side of the fan, and connected thereto by means of a removable coupling, is a 7 by 7-in. vertical piston valve engine. One engine is used at a time, and they are changed once a month.

As shown in the sketch, the steam line comes down from the header above the engines, and branches to both engines. Just above the branch in the vertical pipe is a regulating valve. This valve is of the plug type ported so that the steam passes through it. The projecting stem of the valve is squared on the end and carries a lever



REGULATING DEVICE FOR STOKER ENGINE

about 8 in. long. A weight hangs on the end of this lever which closes the valve by gravity. A light chain passing over pulleys connects this lever to the water piston rod of a damper regulator, which, in this case, is not connected to the dampers, but could be if desired. When the steam pressure drops below normal, the pressure on the under side of the regulator diaphragm is overbalanced by the weight on the lever of the regulator, and the water is allowed to escape from the cylinder. The weight on the piston rod on the water cylinder causes it to drop, and the steam valve is pulled open, admitting steam to the engine. The throttling governor on the engine is adjusted for a maximum speed that will give about 1.75 in. water pressure in the air duct. When the engine speeds up the stokers are likewise speeded up, and the increased heat of the fire soon increases the steam pressure to normal, which causes the regulator to work in the reverse manner, pushing the weight on the piston rod up, and the weight on the steam valve lever closes the valve, thereby shutting off steam to the engine. When the lever of the steam valve is released, however, the valve cannot close tight because a set screw in the arm under the lever prevents it from dropping low enough to close the valve tight. The low speed of the engine is usually set at about 160 r.p.m., and the high speed is as a rule about 450 r.p.m. When more boilers are added or the load increases, no change is made in the regulation of the speed; the increased load is taken care of by the fan running at the higher speed for a greater part of the time. There is a bypass around the steam valve so that it may be removed if necessary for repairs. Ordinarily this bypass valve is closed tight. During extreme cold weather, when the boilers are heavily overloaded, it is necessary to increase the fan speed by adjusting the governor so that a pressure of 2.3 in. is maintained in the air duct when the fan is running at full speed. The regulator is bolted to the side of the boiler, and the steam line is connected to the header.

This system is entirely automatic in its action, holding the pressure within 2 lb. of normal with any change of load; but I believe that in a case of this kind, the speed of the stoker and fan should be uniformly steady and changing in proportion to the load on the boilers. This arrangement, however, does not permit of this. With any fan engine which gives a high and low speed, and a correspondingly high and low air pressure, there are times when an enormous quantity of excess air is blown into the fire at a time when the fire is low, which causes a great loss of heat. With the arrangement shown in the sketch, this can be overcome to some extent by setting up the set screws so that the minimum speed will be as high as possible without running the steam pressure up too high. The speed at which the fan shall run when slowed down is governed by the minimum load on the boilers unless the speed is changed each time the load changes. J. C. HAWKINS.

Leakage of Ammonia

THE QUESTION is often asked, "Where does the ammonia go?" We assume that there are no visible leaks that can be detected in the plant by ordinary test methods, and the disappearance of the ammonia slowly but surely seems a mystery.

I think there is very little mystery about it. The materials from which pumps, engines and piping are made, are not absolutely impervious to gases. A vacuum cannot be maintained in a vessel by keeping it closed, for air will penetrate the metal and eventually destroy the vacuum. If air penetrates a material under a fraction of 14.7 lb. difference in pressure, ammonia under 120 to 180 lb. pressure may certainly be expected to

escape with appreciable rapidity, especially as its density is less than that of air. The absence of odor proves nothing, for leakage in this way may be very slow and slight, and the escaping gas would rise instantly, being lighter than air, and could not be detected by the sense of smell. Even where we think all fixtures tight and we do not smell illuminating gas (much heavier than ammonia) in our houses, plants and flowers suffer from its presence. In large buildings, where the gas piping and fixtures are quite extensive, the meter advances perceptibly during a period of 10 or 12 weeks when no gas is burned and all fixtures are in perfect order.

A. MONIA.

Care of the Cylinder

ONE OF the most provoking incidents in the starting of a new engine is the scratching or scoring of the cylinder. And this may happen in spite of all care and caution exercised by the engineer. The steam line and cylinder should be thoroughly blown out, at full boiler pressure, before valves and piston are in place.

The cylinder should then be opened up and cleaned out. Core sand, borings, slivers of iron and other dirt are blown out, and some of this will remain in the cylinder bore, and can be seen when cylinder is opened. After it has been well cleaned, give it a coating of cylinder oil. When the engine is ready to start, after piston valves are in, the engine should run very slow; in fact, as slow as it will move. The lubricator should work freely and if there is a hand pump on the cylinder, feed cylinder oil, mixed with a small quantity of graphite, through it. In the event of any core sand or grit yet remaining in the cylinder, the slow moving piston will push it out, without scratching the cylinder, which it might do were the piston moving faster. It is necessary to have the piston valve and cylinder surfaces acquire a glaze, and this is obtained by the heat of the steam, the oil and the friction of the surfaces on each other. After the glaze has formed, the danger point is passed, usually, if the cylinder gets sufficient oil afterwards. The engine can be gradually speeded up until it is full speed. The time needed to bring an engine to full speed varies as to conditions, and no specified time can be set.

The common cause of scoring cylinders are core sand and borings, steam too wet, poor cylinder oil, poor iron in the cylinder, edges of piston and rings too sharp, too much haste in speeding up the engine, too tight fit of piston or rings, improper alinement of engine.

A steam separator on the cylinder is of great advantage, as it insures dry steam to the cylinder, and also, if large enough, acts as a reservoir for steam. The separator should always be connected to a steam trap—one that will work. There is a great difference in cylinder oils, and what works well in one engine may not do so well in another. Every engineer has his favorite brand, to which he clings, after trying various kinds. It is a great deal like finding the right food for a bottle baby.

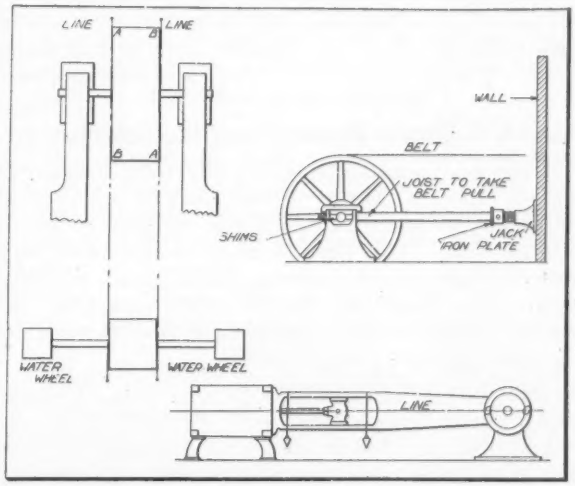
Some cylinders are composed of iron which is exceedingly difficult to glaze. The writer came across one recently which was run under speed for 12 days, before the load was put on. The piston should be small enough to allow for its expansion before the cylinder walls and to allow for free movement throughout the cylinder. Enough should be cut out of the packing rings to allow for expansion, and they should not bind in their grooves. The corners of piston and rings should be rounded, otherwise the lubricating oil will be scraped off the cylinder walls and the piston will receive no benefit. After the engine has been run some time, it is well to remove piston, and round the edges of rings with a file, as they will be found to have sharp corners.

If the engine is out of line, or the piston rod is high or low in the crosshead, the cylinder will wear uneven and there is also a tendency to knock. A cylinder wearing this way is apt to cause more leakage past the piston than there would be were the engine in line. The only remedy for this is to line the engine, and if the cylinder is bad to have it bored. TOM JONES.

Curing a Pound

ON TAKING charge of one of the plants under the writer's supervision, it was found that one of the cross-compound engines was developing a heavy pound at the pillow block on the low pressure side, and investigation brought out the following facts.

As the engine is run in conjunction with water wheels, the engine load is variable, and during seasons of overflowing river, the wheel development is such that the steam power needed to make up the total can be developed to advantage in the high-pressure cylinder, so the low is disconnected, the piping being provided accordingly.



METHOD OF TESTING AND ADJUSTING ALINEMENT

As the engine had run so long under these conditions, the high-pressure main bearing had the most wear and had been taken up the most, so that the shaft was thought not to be square with the center lines of the cylinders. Again, there were no collars on the shaft to limit the endwise travel, the disk-cranks taking their place. It was thought that there was a little too much end motion, and that when the shaft was properly squared, this end play would be corrected.

A line was run across the side of the flywheel and receiving pulley on the jack shaft on each side of the pulleys, and it was seen that the lines touched the rims at the points A A, and not at the points B B. The engine was turned over a half revolution, which verified the previous result.

The distance between the crankpin boxes and the crank disk was calipered when on both centers, and proved what was learned from the line, that the end of shaft in high pressure bearing had to be moved forward.

Two pieces of 8-in. square joist were obtained, one end of each cut to fit the curvature of the shaft, and of such length that a jack could be placed between them and the wall to take the belt pull, and allow the shaft to be moved and held as desirable, care being taken to have the center line of the joist in the same plane as the center of the crank shaft.

After loosening the thrust screws on the high-pressure bearing, a strain was applied to the jacks, and the shaft moved until the rim of the flywheel touched the 2 lines at all points.

The cap was removed from the bearing and the back quarter box moved up solidly to the shaft, then the distance between the box and jaw of casting was measured and suitable shims were inserted to hold the shaft where it belongs.

The bearing was reassembled, the jack and joist were removed and a line was run along each frame touching a plumb line at each end of the guides run past the crank disk. Measurements were taken from the line to the crank disk at the points C C on each side of the engine and found to be practically the same, thus checking up the result.

The engine was started and the bearing adjusted; the pound had been removed, and the operation was satisfactory to all. Two men with the material named did the job in 2 hr. RECEIVER.

A Governor Problem and the Solution

A 300-HP. CORLISS engine was originally designed to run at 75 r.p.m.; but as it was desirable to run it at 38 r.p.m., the governor pulley was replaced by one of a larger diameter to meet the requirements. This work was not done by the makers and the result was very poor. We bought the engine secondhand after the change had been made, and as we desired to run it at 38 r.p.m., we met with difficulties.

Under no load the governor worked well. When the load was picked up, however, the governor would not fall till the engine had slowed down an objectionable amount. When it did act, it moved much farther than necessary, giving too late a cutoff and causing the engine to race. Again, it would remain stationary while this unnecessary speed was gotten up, when it rose as high as possible, shutting the steam off entirely. Each time the cycle recurred, conditions were made worse; so that finally the engine would stop entirely before the governor was ready to admit some steam.

It was apparent that the flyballs were too heavy, resulting in an objectionable amount of inertia delaying the action of the governor as a whole. We attacked the matter thus: In order to reduce inertia, it is necessary to reduce weight. As, however, centrifugal force varies as the square of the velocity and directly as the weight, the removal of every unit of weight must be balanced by a proportionate increase in velocity.

We decided, therefore, to double the speed of the governor and divide the weights by 4, thus retaining the original moment of centrifugal force. The 24-in. driving pulley was replaced by a 48-in. pulley, to drive the governor at 200 instead of 100 r.p.m. The 32-lb. balls were removed and 8-lb. balls attached.

Now, examining the element of inertia under the new conditions, we find it to be reduced by 50 per cent, thus: Momentum varies as Weight $\times$ Velocity.

Then, with 32-lb. balls at 100 r.p.m., Inertia $= 32 \times 100 = 3200$.

With 8-lb. balls at 200 r.p.m., Inertia $= 8 \times 200 = 1600$.

Under working conditions, the change proved to be exactly what was required; we now have a satisfactory governor. H. K. SCHOLEFELD.

Proper Speed of Belts

ACCORDING to N. G. Near's letter in the Sept. 15 issue, under the title "Belts Should Run Faster," he would triple the speed at which belts are run according to present practice.

Mr. Near states that 12,000 ft. per min. has proved an efficient speed for belting. At this speed, 200 ft. per sec., the centrifugal tension per square inch of cross-section of leather belting is $0.012 \times 200^2 = 480$ lb. This exceeds considerably the safe working strength of the belt, and in order that it transmit power it must be tightened to a point that, with the added stress, would soon prove destructive. Another aspect of so high a velocity is the effect on the pulley rims. The tensile stress per square inch of cross-section in a cast-iron pulley rim due to a velocity of 12,000 ft. per min., or 200 ft. per sec. is $0.0972 \times 200^2 = 3888$ lb.

A stress of 2500 lb. per sq. in. in cast iron is seldom exceeded in ordinary machine design where the magnitude of the actual stress can be fairly approximated. In the case of a pulley rim, however, there is the direct tensile stress due to centrifugal force and transverse stresses due to the tendency of the rim to bulge between spokes and to the effect of the belt pull. The combined effect of these stresses is somewhat uncertain and calls for a large factor of safety.

Common practice limits the speed of cast-iron pulleys and flywheel rims to a mile a minute or 88 ft. per sec. This speed causes a direct tensile stress of 750 lb. per sq. in. in the rim. It would seem, then, that a speed of 12,000 ft. per min. and its consequent stress of 3888 lb. per sq. in. would be decidedly unsafe.

C. O. SANDSTROM.

ACCORDING TO experiments that have been performed on belts in Germany, high-speed belts are preferable, as stated in my letter in the Sept. 15 issue of Practical Engineer.

I do not know what materials were used in the tests that ran beyond 12,000 ft. per min.; but it is my impression that leather belts were used, and on steel pulleys.

A speed of 12,000 ft. per min. is only twice as fast as our present allowable speeds, although, I admit, such

a speed is "pretty fast." Yet, with the high factors of safety ordinarily used in our belts and pulleys, it can easily be shown that the best grades of leather and the best steel pulleys would be safe at 12,000 ft. per min.

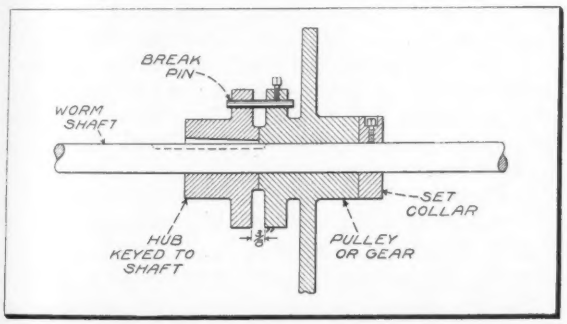
Cast-iron pulleys and ordinary laced belts should not be run over 5000 ft. per min., of course, and I would not advocate a higher speed than that under any condition where the materials would be unsafe.

Over 15 yr. ago, we used belt formulas in which 400 lb. per sq. in. was allowed in cemented and riveted belting. Today we should do better than that, for the strength of the solid leather in the belts we ordinarily use varies from 2000 to 5000 lb. per sq. in. Then, with the best leathers we would still have a good factor of safety at twice our present speeds.

Steel belts have been used somewhat over in Europe, and at speeds as high as 330 ft. per sec., or 19,800 ft. per min. The speed feature is one of the big advantages claimed for steel over leather; but I am not an advocate of steel belts yet, for I do not know enough about them, having had no experience with them. It is my opinion that leather belts are much more convenient to use in most work, and I know that they are highly efficient where properly cared for. N. G. NEAR.

An Economical Drive

A LARGE PROPORTION of freight elevators used in factories are worm driven. The worms are usually made of steel, and the worm wheels of bronze. It is a common practice to overload these elevators, with the result that the worm wheel breaks. These wheels are expensive, and their initial cost added to the cost of replacement, and that of the use of the elevator while repairs are being made, is a serious item.



GENERAL CONSTRUCTION OF AN ECONOMICAL ELEVATOR DRIVE

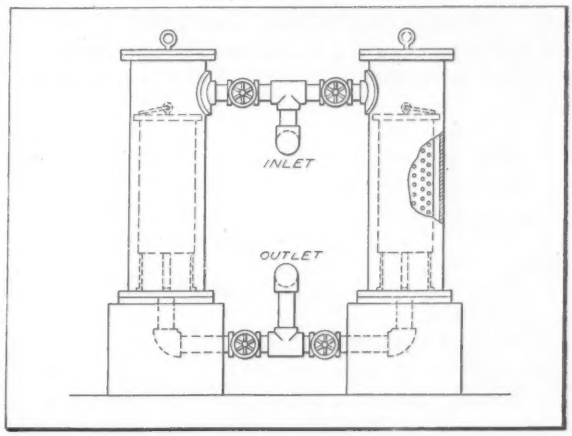
A simple method of preventing this breakage, and one wholly reliable, is explained as follows: A cast-iron hub of suitable size to be bored to fit the worm shaft is keyed to the shaft. The hub has a flange about 3 in. larger than the body of the hub, and for a 10-ton elevator about 2 in. thick. A pulley, or if motor-driven a gear, is made with a similar flange. This gear or pulley runs loose on the shaft. A hole in line is drilled through each of these flanges to receive a cast-iron pin. A set screw is put in one of these flanges to prevent the pin from working endwise. When the elevator is overloaded, the pin breaks, and the pulley or gear is free to revolve. The breakage is confined to a pin. A ⅜-in. cast-iron pin is the sum total of the cost of what is ordinarily a $50 expense. The repair can be made in less than 5 min. if a stock of pins are kept on hand. I have driven a 10-ton elevator with a ½-in. pin.

The drive should be boxed, and locked to prevent the insertion of a steel pin by a workman who wanted to hoist more than the capacity of the elevator.

The writer introduced this device to one of the largest agricultural works in Chicago several years ago, and there has not been a broken worm wheel in that plant since. Previous to this time, there had been over 150 broken in 5 yr. AN OLD SUPERINTENDENT.

Homemade Twin Strainer

THE INTERIOR of this apparatus, that is the strainer proper, consisted of a cylindrical shell made of sheet iron with ⅜-in. holes punched 1 in. apart and having a diameter 2 in. less than the internal diameter of the outer casing. This was then provided with 4 legs as shown. The tip of the cylinder shell was flanged



HOMEMADE TWIN STRAINER

outward 1 in. and a flat ring having a width of 1 in. and an external diameter equal to the internal diameter of the casing riveted on.

Two eyebolts were screwed into the top flange of the casing so as to facilitate removal of this member preparatory to cleaning. L. K.

Now that Winter is Coming

THE DAYS are getting shorter and we must use our lighting means more than usual, however efficient, or otherwise, it may be. Now is the time to do the repairs that we know will be needed as soon as the load gets heavier with the increasing lighting load. Then, too, you remember the time last year when the production fell off in some of the departments because of poor distribution of light. Then we also might get busy on the guy anchors to the stack before the winds get so rough that we have more trouble. We don't want a lot of bearings to fix up at the last minute while we are busy getting the heating plant in operation. In fact, I believe that we had best get together and make a list of all the things that should be done; lay out a schedule, and *work by it*. It will be only by this means that we can avoid the trouble and expense of the year before.

H. E. WEIGHTMAN.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Load Distribution in Compound Engine

WILL SOME of the readers of Practical Engineer kindly tell me of the best method of distributing the work done in a cross-compound engine under variable loads and with fixed cutoff on the low-pressure side?

How can I find the most economical receiver pressure at various loads?

What is a snifter valve? T. N.

Engine and Boiler Questions

WHAT IS meant by an engine being economical?

2. How many inches of mercury does a perfect vacuum have?

3. What is an adjustable cutoff and how does it work?

4. What is ratio of expansion?

5. What is compression in an engine? How does it work?

6. What 3 ways of firing are there and which one is used the most?

7. What relation exists between pressure and lift of the safety valve?

8. What is meant by a hydraulic pump and how does it work? What are they used for? W. A. D.

ANSWERS

AN ENGINE is economical when it uses but a comparatively small amount of steam per hour per horsepower. The exact amount will depend on the type of engine and the condition, but for an engine in good shape, a simple D valve engine will use from 40 to 50 lb. per hour per horsepower; a Corliss simple, from 20 to 30; a high speed compound, 20 to 30; Corliss compound, from 18 to 25.

2. A perfect vacuum at sea level will have 30 in. of mercury. At a higher level, the perfect vacuum would be less, since the atmospheric pressure is less, but the amount of perfect vacuum at any place, and at a given time, depends on the height above sea level and on the condition of the atmosphere.

3. An adjustable cutoff is one arranged so that the engineer, by means of some device which may be a link, or a movable knockoff cam, or a right and left sleeve for changing the length of the valve rod, can vary the cutoff at will. In some engines, this may be done with the engine running; in others, the adjustment must be made when the engine is shut down.

4. The ratio of expansion is the ratio of the absolute pressure of steam admitted to the cylinder, to the absolute pressure at the end of expansion, or at the time when the exhaust valve opens.

5. Compression on an engine is the increase in pressure of the steam caught in the cylinder when the exhaust valve closes. The ratio of compression is the ratio of the absolute pressure at the end of compression to the pressure when the exhaust valve closes, or to the exhaust pressure. This compression works to fill the clearance space with steam at a comparatively high pressure, thus reducing the steam required at admission to fill this space.

6. The 3 ways of firing are: Spread firing, in which coal is fired all over the fire bed each time; alternate firing, used when there are 2 firing doors, where one side is fired and then the other, alternately, and the coking system, in which the coal is thrown onto the dead plate just in front of the firing doors, and the gases and tarry matters are allowed to distill off, so that the coal is practically formed into coke. Then this coke is pushed back onto the bed of the fire and a new supply fired on the dead plate. With anthracite coal, the spread firing is usually used. With bituminous coal, whether the alternate or coking method is better depends on the furnace and the kind of coal. Some kinds of coal are what is called "non-coking"—that is, they melt and break up into fragments when heat is applied. For these, the alternate system of firing is the better. With a coking coal and a sufficiently high combustion chamber to burn properly the hydro-carbons which are distilled off, the coking process will be found quite satisfactory.

7. The greater the pressure, the higher will a safety valve lift. The reason for this is, that the amount which you can compress a spring depends directly on the force which you apply, and with a greater pressure, you have a greater force to compress the spring, and therefore to lift the valve.

8. The name "hydraulic pump" is usually applied to one intended to pump against high pressures, such as are used in testing work and for hydraulic pressure, where the pressures usually run from 500 up to 2000 lb. per sq. in., although in some special cases, pressures as high as 6000 or 8000 lb. per sq. in. have been used.

A. L. R.

Boiler Construction

WHY IS the middle sheet of a boiler laid on top of the end sheets? SUBSCRIBER.

A. There are 2 reasons why the 2 end courses of a boiler shell lap over the third or middle section. First: The natural tendency for any enclosed vessel subjected to internal pressure is to assume a spherical shape, as, for instance, soap bubbles, or a common toy balloon, and because a boiler is constructed of metal sheets of considerable resisting strength, does not alter this natural law.

Thus it is that this natural tendency to force the boiler into spherical shape is greatest at a point halfway between the heads, which is at the middle course. By

lapping the end courses over the middle one, the former have a certain restraining influence over the latter, whereas if the middle section or course overlapping the end courses, this restraining influence would not only be lacking, but the rivets would be subjected to a tension stress as well as a shearing stress.

Second: If the boiler be of the externally fired return tubular type, the middle course is immediately over the bridge wall and as it is here that the heat of the furnace impinges upon the boiler with the greatest intensity, the boiler would be subjected to harsh treatment as scale would naturally form in the lowest part of the boiler to the detriment of the sheet over the bridge-wall.

If you will study the location of loose scale in a return tubular boiler that has been gradually cooled off and slowly emptied, you will generally find that the loose scale will form mostly over the bridge wall, even with the end courses lapping the middle course, and if the middle course laps the end ones, the opportunity for lodgment of loose scale here will be increased to the detriment of the life and safety of a boiler.

G. H. WALLACE.

Why the Drop?

WILL YOU please inform me how to find the efficiency of a turbine due to its vacuum? In our plant the vacuum has dropped ½ in. in 1½ yr. and we cannot locate the trouble. O. W.

A. We presume, from the nature of your letter, that what you want is how to remedy the difficulty you are having with poor vacuum, rather than how to tell what effect poor vacuum has on efficiency.

The factors which might cause decreasing vacuum are: Leakage of air into the exhaust system through bearings or pipe joints; insufficient supply of cooling water, or the water at too high an incoming temperature, or if it be a surface condenser, the tubes may have become coated with scale, reducing their effectiveness.

The way to test for leaks is to go over all joints with a thin mixture of water and whiting, just sufficient to show on the joint well, to see whether you find an inward suction at any point. If so, the leak must, of course, be remedied.

As to the amount of cooling water used, if you are using all that is available, of course there is no remedy, and usually, if the incoming temperature is too high, it is a matter of water supply and cannot be taken care of.

As to the coating of tubes in a surface condenser, this can best be determined by taking out one of the tubes to see what condition it is in. If your cooling water has a large amount of scale-forming material, which may have deposited on the tubes, it would have the same effect as scale in the boiler.

There is, also, a slight possibility that your vacuum pumps may be leaking, therefore not pulling the vacuum as they should. If this is the case, the vacuum could be somewhat improved by speeding up the pumps. The remedy would be to repack the pistons, if you have reciprocating pumps.

You do not give the actual vacuum which you maintain, nor the size of your plant, nor any other data which might enable us to judge what the performance of your condenser is. If you are maintaining, however, a 28.5-in. vacuum, with cooling water at an average of 50 deg. F., you would require about 25 lb. of condensing water to a pound of steam condensed, and your final cooling water for a surface condenser should be at about 85 to 87 deg. F., as the temperature of steam corresponding to 28.5-in. vacuum is 92 deg. F.

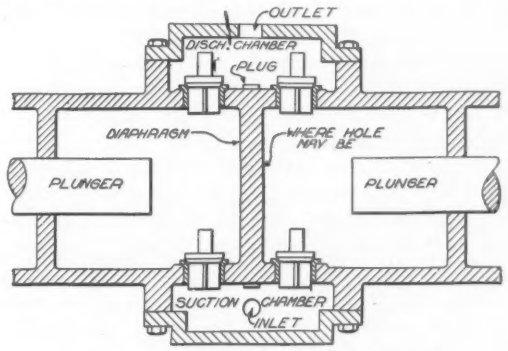
A. L. R.

An Unusal Pump Failure

SUPPOSE YOU are operating a large hydraulic pump, on the discharge of which you carry about 2000 lb. pressure. Suppose this pump without any apparent cause suddenly fails to keep this pressure up, and with the suction pipe cold the pump becomes steam bound; in fact, the pump barrel becomes so hot that you cannot keep your hand upon it—what is the trouble?

A. A leak has developed in the pump, possibly a leaky discharge valve.

2. While this is a possible cause, it is not the cause in this case. Valves are tight, and the check in the discharge line is tight, so we know that the water is not coming back from the discharge line. Where is the leak now?



PUMP CYLINDER THAT GAVE TROUBLE

A. It must be in the pump body, and is likely in the diaphragm, or partition wall that is between the 2 plunger chambers, as shown in the sketch.

3. What will cause a hole in this diaphragm?

A. If it is a hole it is likely due to a flaw in the casting, but if it is a crack it generally is due to excess pressure.

4. Why should this hole in the diaphragm cause the water to become so hot that the pump becomes steam bound, with the suction water cold?

A. This is due to the friction of the water as it passes from one side of the pump to the other side, under a high pressure. Minor leaks in the metal seat of valve used in high pressure service will have the same effect.

5. How hot may the water become under such a condition?

A. Hot enough to form a vapor, or steam which will destroy the vacuum in the pump. It is claimed that it is possible to make water boil under these conditions, but before this condition exists, the pump will be racing badly.

6. How may a pump be tested for a leak in the diaphragm?

A. Plug all suction valve openings and fill one side of the diaphragm with water; if water shows on the other side, it must be passing through the diaphragm. A better method, but one calling for more time and work, is to remove the outer plunger, plug all suction valve openings, also the discharge openings in the outer end of the pump, pipe, city pressure or any water line that is under pressure to the discharge chamber of pump. Now, if there is a leak, when the water is turned on it will pass into the discharge chamber, into the suction chamber and through the hole in the diaphragm to the side from which the plunger has been removed.

7. Why will the first method given above sometimes show no leak, and the second method show a bad leak?

A. It is due to the fact that the hole or crack may be so small that unless pressure is applied the water will not pass through. Of course, the higher the pressure the faster the water leaks by.

8. How may a pump with a hole, or crack in the diaphragm be repaired?

A. In nine cases out of ten, repair should not be attempted, and especially is this so where the pump is doing heavy work. A new casting is the cheapest, most reliable, and easiest method of making such a repair. In the tenth case, the pump may be repaired if the hole is located and is very small. In the top of the pump casting between the valve caps will be found a smooth spot. This spot is actually a plug, under which is a hollow core to the bottom of the casting where is another plug, if this top plug is drilled out and the core cleaned, and babbit run in, it is possible that the hole in diaphragm may be closed up. An attempt to repair a crack in a high-pressure pump is generally wasted time and money.

9. It seems foolish to leave this core in the casting, as it must weaken the general construction of the pump. Why is it done?

A. It is a provision made for the escape of the hot gases, which would cause blow holes in the casting, in a place where they might not be detected.

10. Would it be possible to tap out and plug a very small hole of this sort?

A. Owing to the construction and design of the usual hydraulic pump, a job of this sort is best left alone. It can be done in a large pump works, but at best it is likely to be a temporary job.

11. To get this new casting, what parts would you send to the pump maker?

A. I should send the water end, with the plungers removed. I would send the pedestal, the packing glands, the valves and the valve caps. By sending all these parts I am saving myself the fitting of these parts when the cylinder is returned. A. D. PALMER.

Reduction of Pressure Reduces Boiling Point of Water

WHAT EFFECT will the sudden opening of the throttle of an engine or the safety valve of a boiler have on the water line in the boiler? READER.

A. In a boiler under pressure and at rest—that is, with no steam being used—the water is at a temperature equal to the pressure. Any attempt to relieve this pressure, such as at the safety valve, or by opening the throttle or other large valve, reduces the pressure a certain amount, although it may not be visible on the gage.

This reduction in pressure immediately renews the process of ebullition (boiling) in the water, which up to this time has been in a state of rest. The passage of this multiple of small bubbles to the surface of the water will tend to raise the water line in the boiler to quite an extent, possibly as high as 3 or 4 in. under certain conditions. GEO. H. WALLACE.

Hot Switch Blades

WHY WILL one blade of a double-pole knife switch heat while the other will not? All connections are tight. This switch is used in connection with a moving picture machine operating on a 110-v. 60-cycle circuit. S. S.

A. The only possible explanation for one blade of your switch getting hot while the other does not, is either a poor contact at some point, which must be from dirt or corrosion, as you say the connections are all tight, or else there is some defect in the switch blade, which increases the resistance. This may be a hole in the material, which is, however, very unlikely, or it may be a partial breakage, which cuts down the conducting area. The dirty contact is, however, the most likely trouble, and that is the thing which you should go after.

There is the faintest possibility that this hot blade may be a hard copper, which by some oversight did not get annealed during the process of manufacture. We would not think, however, that this would be likely to increase the resistance sufficiently to cause any great amount of heating of the blade.

In case you can find nothing the matter with the switch, look for a double ground; one on the line which passes through the hot switch blade, beyond the switch, the other on the line which passes through the cool blade, between the switch and the supply line. Such a ground would pass current through one side of the switch and not through the other, the circuit being completed through the 2 grounds. A. L. R.

Mass. Examination Questions on Steam Turbines*

WHAT IS the amount of clearance in a De Laval?

A. One-eighth inch.

17. What is the average speed on a De Laval?

A. Large ones 10,000 r.p.m. to 30,000 for smaller ones.

18. How is this speed reduced (De Laval)?

A. It is reduced about 10 to 1 by the helical gearing between driving shaft and turbine wheel.

19. How is the turbine wheel attached to the shaft on a De Laval?

A. Flexible coupling.

20. What kind of a turbine is the Curtis?

A. Impulse.

21. How does the steam act on the Curtis?

A. The steam is expanded in stationary nozzles, getting a high velocity, then passing through movable and stationary buckets without more expansion.

*Continued from page 977, Oct. 15 issue.

22. How does steam work in a reaction type?

A. There are 2 distinct nozzles, the steam is expanded in both stationary and moving blades and actuates the latter by both impulse and reaction.

23. Tell how the steam goes to the Curtis?

A. Steam enters the steam chest, and through one or more open valves to the bowls. The numbers of valves open depends upon the load and through action is controlled by the governor. The steam expands through the divergent nozzles, entering the first row of revolving buckets of the first stage, then through stationary buckets which reverse its action and direction, and direct it against the second revolving row. This completes one stage or pressure chamber, having entered the first row of buckets with relatively high velocity. It leaves with it a relatively low velocity; its energy between the inlet and discharge has been abstracted. It has, however, a large amount of unexpected energy. The expansion process, therefore, is repeated in a second stage and in larger sizes up to 7 stages.

Setting Corliss Valves

WILL YOU please tell me how to set the valves on a double-eccentric Corliss engine? P. C. V.

A. In order to obtain a greater range of cutoff in a Corliss engine, a separate steam and exhaust eccentric is used. With 2 eccentrics the admission and exhaust valves can be adjusted independently, and steam may be cut off anywhere nearly to the end of the stroke.

The work of setting the valves of a Corliss engine having 2 eccentrics is not particularly complicated, as many engineers seem to think. After knowing in which direction the engine is to run, finding the direction in which to turn the eccentric becomes a very simple matter. When setting the steam valves, we have one eccentric to turn, as in the case of the single eccentric engine, and when setting the exhaust valve, another eccentric must be turned, but this does not add complication to the work, although it requires a little more time. The work of centralizing the positions of the various parts, equalizing the movements and setting and adjusting the gear is practically the same as with the single-eccentric engine.

Set the wristplate central, and adjust the valve rods, but in this case the steam valves are set with negative lap, which is usually a little less than half the port opening. The first step is to set the exhaust eccentric (as it is placed next to the bearing), then turn the engine until the piston is in the desired position, so as to obtain a compression of about 5 per cent of the stroke, then turn the exhaust eccentric loose on the shaft, in the direction the engine is to run, until the exhaust valves are line and line; then secure the eccentric.

The next step is to set the steam eccentric; place the crank on either one of its dead centers, then turn the steam eccentric loose on the shaft until the steam valve at the end where the piston stands has the required opening or lead, which varies from 1/32 to 1/8 in., according to the size and speed the engine is to run.

Separate eccentrics require separate wristplates, which are usually placed on the same pin.

Where lap is used on the exhaust valve, it has the effect of making earlier compression and later release. A valve gear designed to be operated by a single eccentric cannot very well be made to cut off much later than at half stroke, even when a separate eccentric is added, for the slow initial valve motion requires at least half the throw of the eccentric, and the other half is not sufficient for a late cutoff. However, the range of cutoff may be extended by moving the eccentric back, sacrificing the lead, and to this there is no objection when it does not involve later release.

The advantage gained by a second eccentric would consist of more compression and earlier release. After setting the valves and making the final adjustment, it is necessary that an indicator be applied to the engine when at work to verify the adjustments of the valves for the best possible conditions for economical operation.

O. H. H.

Centering of Pistons

How DO you center a piston in a cylinder?

If, after it was centered, you could not get the follower plate on, what would you do, and what would be the trouble? S.

A. There are several types of pistons in use in steam engines, some of which are adjustable for centering, more or less, and others are not. The solid piston is not adjustable, and its use is confined chiefly to small units, or to vertical engines.

In the built-up pistons, there is usually the spider, or the part that is pressed directly onto the rod, and the bull ring, or junk ring, and the follower. There will also be steam packing rings of some sort, but they do not affect the problem at hand.

The spider is rough turned and bored to fit the rod and pressed on, after which the spider is machined to size. The spider, generally, is provided with several adjusting screws with jamb nuts, located in such a position that when the bull ring is put in place, the screws can be used to adjust it concentric with the piston, and as the follower is a machined fit on the bull ring, it must fit the same as the bull ring.

In centering a piston in a new cylinder, or one that has been accurately rebored, caliper carefully from the shoulder of the spider to the walls of the cylinder, and adjust the screws as required until it calipers the same all round.

In a cylinder that has been worn, place the piston in such a position that the shoulder of the spider will project over the counterbore enough so that the calipering can be done on a surface known to be accurate.

In some designs of pistons, the follower sets into recess in the bull ring with a clearance of perhaps 1/ in. all around, and if a piston were turned upside down in a cylinder badly worn, it is possible that the wear would be more than the clearance around the follower, in which case it might be necessary to take a cut off the outside edge of the follower.

If the position has been allowed to run for some time out of line, and is then re-centered, it is quite possible for the follower, if it is the full diameter of the piston, to be worn on the bias enough to interfere a little in putting it in place again; but a little filing on the edge, at the troublesome spot, will remedy the matter.

G. H. WALLACE.

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Progress in Industrial Education and Research

Methods adopted in the leading high schools and technical institutions have, in late years, taken a trend toward the practical application of scientific facts to the extent that in all our large cities the elements of all common trades are taught in high schools and principal universities have departments which devote their time to investigating laws governing materials used in all the main industries of the country. The old idea of general courses designed with the object of training and developing the mind without giving the student a grip upon information he can use in his daily occupation seems to have given way largely to courses leading to the application of science to modern industry.

The number of requests which we have had for outlines of study courses from our readers, as a result of the article a few weeks ago on "Your Winter Study Course," is evidence that many in power plant work are striving for a firmer grip upon principles governing the construction and operation of power plant apparatus. That technical high schools are studying the needs of the people in their communities and offering evening courses at little or no cost to those attending is gratifying to those of us who have been striving to have these courses introduced.

Following is the outline of a course designed especially for engineers which is now being given at the Lane Technical Evening School in Chicago one night a week:

Fundamental Principles in the Generation of Alternating Currents; Frequency, Power Factor, Phase and Phase Relations; Inductive and Capacity Reactances—Impedances; Vector Diagrams; Resonance; Measuring Instruments—Ammeters, Voltmeters, Wattmeters, Integrating Wattmeters, Synchroscopes, Power Factor Meters; Types of Alternators, Construction, Advantages and Disadvantages; Exciters; Synchronous Motors; Induction Motors; Transformers; Rectifiers and Converters; Switchboards and Control Apparatus; Protective Apparatus; Calculation of Power in Single and Polyphase Circuits with and without impedance; Calculation of Transmission Lines for Single and Polyphase Circuits.

It would be well for those in other cities to get together a sufficient number of engineers to make a class interested in a course of this nature and arrange with the local school authorities for an instructor and the use of laboratory to carry out the course; unquestionably influence can be brought to bear upon those in power to grant the request and a growing popularity of the course will keep it thriving.

That the industrial concerns of the country recognize the service which can be done by our technical educational institutions is evidenced by a recent communication from the Chamber of Commerce of the United States in which a plea is made to the great university laboratories for assistance to business. In an effort to ascertain to what extent the large universities may co-operate with the representative business establishments of the country in the matter of industrial research, the directors of the Chamber of Commerce have voted that the questions involved be referred to its committee on education or to a special committee. It was further ordered that the sub-

ject be taken up with educational institutions for the purpose of ascertaining the extent to which these institutions may be interested.

We have permitted each field of industry, each line of education and the national government to pursue alone its course of research. The results obtained have been quite independent of each other. These great factors should work together along co-ordinated lines to produce economic advantages to business and educational and social benefits of the greatest value to the people as a whole.

A method of procedure suggested to the National Chamber is to call a meeting inviting thereto the presidents of 12 prominent educational institutions and 12 heads of large industrial or manufacturing plants, each representing a different industry. Consideration would be given to the possibility of each educational institution handling specific problems for the industries, making experiments for them if necessary or desirable, and endeavoring to organize a course of study training their graduates along particular lines that would be of direct benefit to the industries. The understanding would be, in this case, that these manufacturers would be willing eventually to take the most desirable of these students into their plants for the working out of the future scientific development and the problems of manufacture.

If such a plan can be worked out the effects on industry will be almost immediate, resulting in higher economy of production and advancement in scientific investigations.

Water vs. Coal for Heating

As the season for artificial heat approaches one of the big questions confronting us is, how can the atmosphere of the building be put into the most comfortable and healthful condition at least expense?

In answering this question we must consider not only temperature, but also humidity; in fact, if you are provided with only one thermometer it had better be a wet bulb type, for it will represent more closely the temperature of the skin than a dry bulb. It is best, however, to have both dry and wet bulb thermometers.

"Use water for fuel instead of wood or coal," is a suggestion of the United States Bureau of Health and while not to be taken literally, the effect of maintaining proper humidity is a reduction of fuel consumption. If air at 68 deg. is not comfortably warm for a healthy person it is too low in humidity and water should be evaporated into it until it is comfortable. While the average temperature of artificially heated houses is between 70 and 78 deg., a wet bulb thermometer will register below 64 deg., making the humidity around 30 per cent.

By tests it has been shown that with dry bulb registering 65 deg. and wet bulb 58 deg., giving a humidity of 61 per cent, it is more comfortable than when the dry bulb is 74 deg. and wet bulb 56 deg., giving a humidity of 30 per cent; now to raise the temperature from 65 to 74 deg. takes considerable fuel. Since comfort is what is wanted, why not add moisture to raise the humidity and save fuel? The most healthful moisture conditions of the air is when the humidity is in the neighborhood of 50 per cent.

STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC.

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Chas. Sanford Clarke, Sec'y.

Sworn to and subscribed before me this 27th day of September, 1915. Warren A. Lathrop,
Notary Public,
[Seal.] (My commission expires October, 1918.)

U. S. CIVIL SERVICE COMMISSION announces an examination for associate gas engineer, Nov. 3, 1915, to fill a vacancy in the Bureau of Standards, Department of Commerce, Washington, D. C., at a salary of $2000 a year, duties being to assist in the preparation of a gas safety code, and in other work of the Bureau connected with the study and testing of gas appliances and other work in gas engineering.

The following subjects will have the relative weights indicated: Practical questions in gas engineering, 40; thesis (to be delivered to the examiner on the day of the examination), 20; education and experience, 40. Graduation with a bachelor's degree in mechanical, chemical, or gas engineering from a college or university of recognized standing and at least 3 yr. responsible experience in some phase of the design, construction, or operation of gas plants or in the distribution or utilization departments of a gas company are prerequisites for consideration for this position. Applicants must not have reached their 45th birthday on the date of the examination. They must submit to the examiner on the day of the examination their photographs, taken within 2 yr. Apply for Form 1312, stating the title, Associate Gas Engineer (Male), to the U. S. Civil Service Commission, Washington, D. C., or to the Secretary of the U. S. Civil Service Board at principal cities.

XUM

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

The Hammond Water Meter

MEASUREMENT of water or other liquids by means of the Hammond meter consists of alternately filling and emptying tanks of known capacity and recording the number of trips in exactly the same manner that engineers customarily measure water in tanks by hand when conducting tests for boiler evaporation, steam consumption of engines and turbines, or for the duty of pumping engines, the only difference being that in the former case the operation is automatic, while in the latter case it is manual.

The Hammond meter consists of a cast-iron outer casing or measuring tank made in sections bolted together, and divided into 2 sections, B_1 and B_2, Fig. 2, by means of a central vertical cast-iron partition, C. In the upper front section of the meter is a cast-iron compartment, X, which is entirely shut off from the rest of the meter and which contains the valve mechanism.

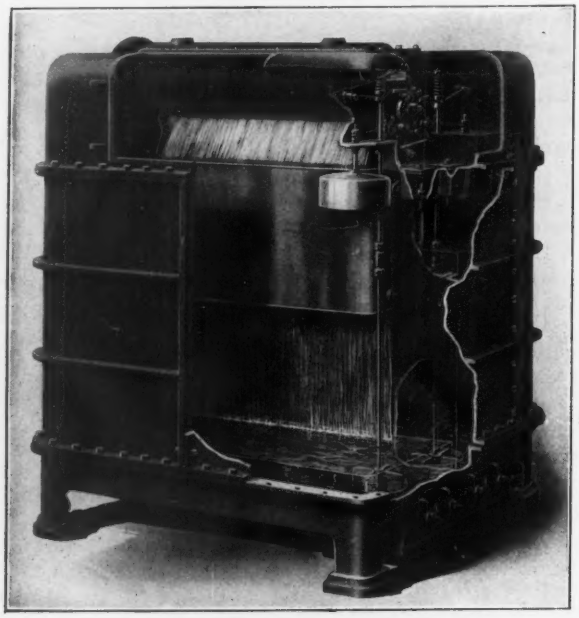


FIG. 1. HAMMOND WATER METER, SHOWING INTERIOR CONSTRUCTION

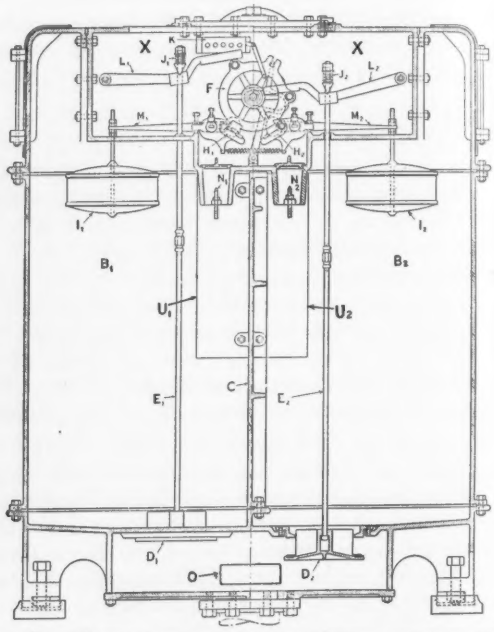


FIG. 2. SECTION OF HAMMOND METER, FRONT VIEW

In back of partition Y (see Fig. 4), and located in the top of meter, is a long horizontal cylindrical cast-iron receiving tank, A, Fig. 3, extending from front to rear of the meter, with a slot in the bottom to allow the water to flow into measuring tanks, B_1 and B_2. Situated directly under receiving tank A is a copper deflector, G, which is known as the tilting inlet valve, and which is so constructed as to deflect the falling water from the receiving tank, A, into either of the measuring tanks, B_1 or B_2. The operation of valve G is controlled directly by wristplate F. These measuring tanks are also fitted with copper baffles, U_1 and U_2, which prevent the incoming water from agitating the surface of the liquid around the floats. The measuring tanks, B_1 and B_2, have outlet valves, D_1 and D_2, opening downward from each compartment. These valves are held up to their seats by valve rods, E_1 and E_2, which are, in turn, operated by lever arms, L_1 and L_2. Copper floats, I_1 and I_2, are hung directly from lever arms M_1 and M_2.

To minimize friction and wear, wristplate F, as well as the rollers upon the rim of wristplate and upon which the levers L_1 and L_2 controlling the outlet valves slide, are mounted upon ball bearings.

The wristplate and latches, H_1 and H_2 are provided with hook blocks similar to those in the valve gear of Corliss engines, and are made of hardened steel.

Gages N_1 and N_2 having metal points, as shown in sectional view, are fitted on each compartment of the measuring tank. The points are set at the factory so that the compartment will contain the exact amount of liquid for which the machine is calibrated. The working parts are then adjusted so that at the instant the liquid closes

over the point, the mechanism trips, and the contents of the compartment is discharged.

Transparent sight glasses, O, are placed in both the front and back walls of the lower section of the meter, below the discharge valves, for the purpose of easily detecting leakage. The accuracy of the meter is thus at all times under constant observation.

Referring to Figs. 2 and 3, with the tilting inlet valve, G, and the wristplate, F, in position shown, the liquid to be measured enters receiving tank, A, through the rear connection and flows through the slot in the bottom, and is then deflected into measuring tank B_1.

Discharge Valve D_1 is held up to its seat by valve rod E_1 and wristplate F, which in turn is held by latch H_1.

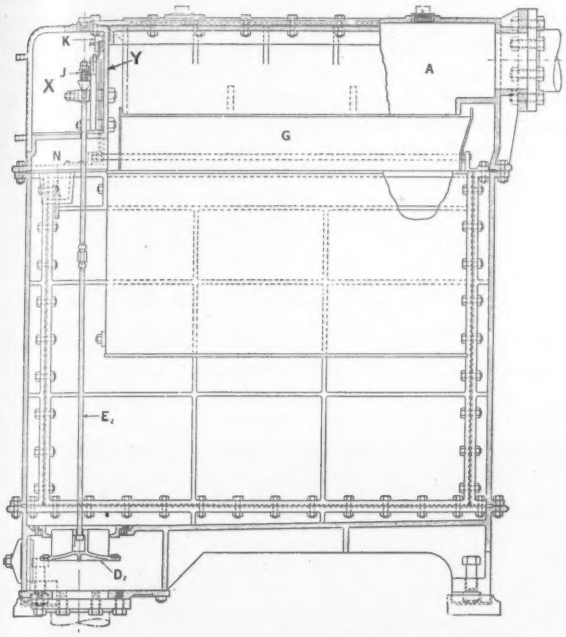


FIG. 4. SECTION OF HAMMOND METER, SIDE VIEW

As the liquid rises in measuring tank B_1 it lifts float I_1, which, through lever M_1, unhooks the latch H_1 and releases the wristplate. The weight of the water on the outlet valve D_1 instantly pulls down the valve and rotates the wristplate. This operation turns the tilting inlet valve, G, to deflect the incoming water into measuring tank B_2, and at the same time draws up the outlet valve, D_2, to its seat, where it is held by the latch, H_2, ready for the water now flowing into measuring tank B_2. Rotation of wristplate F operates counter K by means of a directly connected link. The springs J_1 and J_2 on the upper ends of the valve rods E_1 and E_2 hold the outlet valves up to their seats and keep them from leaking.

The movement of the valve mechanism and the shifting of the tilting inlet valve which deflects the incoming water from the full to the empty tank are simultaneous and instantaneous operations. The time element is said to be negligible.

The standard recording instrument of the Hammond meter is a substantial revolution counter actuated by direct mechanical connection with the valve motion of the meter. No clock mechanism is employed. This counter totals the number of trips, and by multiplying

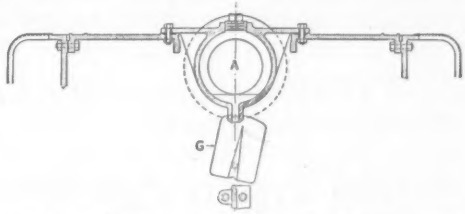


FIG. 3. SECTION BACK OF PARTITION Y, FIG. 4

the number of trips for any given period by constants stamped on the meter, the total can be determined in pounds, gallons, or cubic feet. The pound constant is most convenient for power house use.

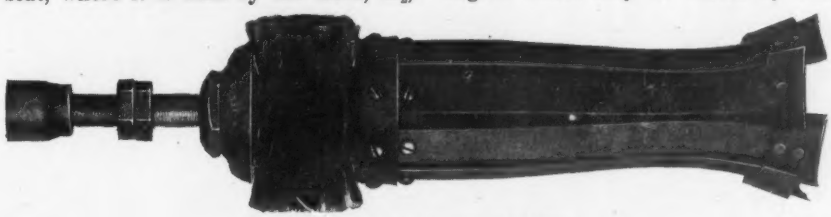
This meter is built by the Alberger Pump & Condenser Co., of New York.

The B. O. E. Tube Cleaner

BUILT to operate with a "hammer and chisel" effect for the removal of scale or soot in steam boiler tubes and flues, this cleaner, known as the B. O. E. or the "Best on Earth" tube cleaner, dislodges scale and soot in a manner said to give the tubes a surface as smooth as the bore of a rifle.

As shown in cut, the main portion of this cleaner carries a series of 8 crucible-tool-steel prongs, to the ends of which are solidly riveted case-hardened knives, of such lengths that one set placed alternately is approximately ½ in. ahead of the other. Directly back of this cutting mechanism is a wire brush having a diameter equal to that of the tube.

Passing through the body of the cleaner is a short unattached piece of pipe, one end of which is threaded and carries 2 lock nuts and a reducer to attach the operating handle; to the opposite end and between the prongs is securely fastened the driving piston which, when driven home, causes the prongs to expand to a degree which may be varied by changing the position of the lock nuts referred to above.



THE B. O. E. TUBE CLEANER

When inserting the cleaner into a tube, the prongs are in a contracted position, and as a result, enter very easily. But, as any noticeable thickness of scale or soot is encountered, or as the brush enters the tube, the pressure exerted by the operator on the piston rod forces

the driving piston against the prongs and causes them to spread. This forces the cutting edges of the knives under the scale, resulting in its entire removal. Should any particle of scale cut loose by the knives fail to ride out on the prongs it will be removed by the brush so that but one operation is required for each tube.

When the cleaner has reached the opposite end of the flue or tube and is withdrawn, the prongs automatically contract, allowing its ready removal.

Any wear of the knives may readily be compensated for by changing the position of the lock nuts on the piston rod, the wear being such that the knives are self-sharpening.

The B. O. E. tube cleaner is made by E. C. French & Co., 610 Monadnock Bldg., Chicago.

A New Type of Pipe Joint

ILLUSTRATIONS herewith show a new style of joint for pipe lengths and fittings, which gives freedom from any possibility of packing troubles, as no gaskets are used, nor is a ground joint depended on for tightness.

The drawing shows some of the fittings, with principal dimensions now being installed on header work at the Northwest Station of the Commonwealth Edison Co., of Chicago. It will be noticed that a small V is provided between the edges of the flange where the joint is to be made. In the case of a flange union on pipe, steel pipe is run through the flanges, and the weld is made between the ends of the pipe. In the case of fittings and valves, the flange is specially shaped to provide the welding V.

These joints have been in use for a year and a half, in various sizes, so that their reliability has been thoroughly proved, and are being installed in the North-

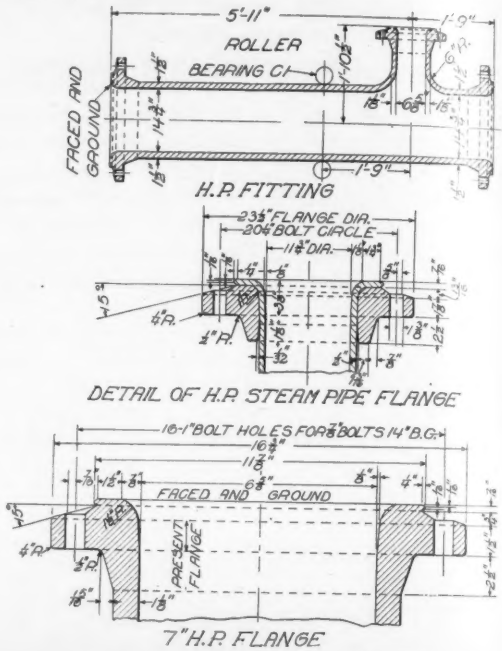
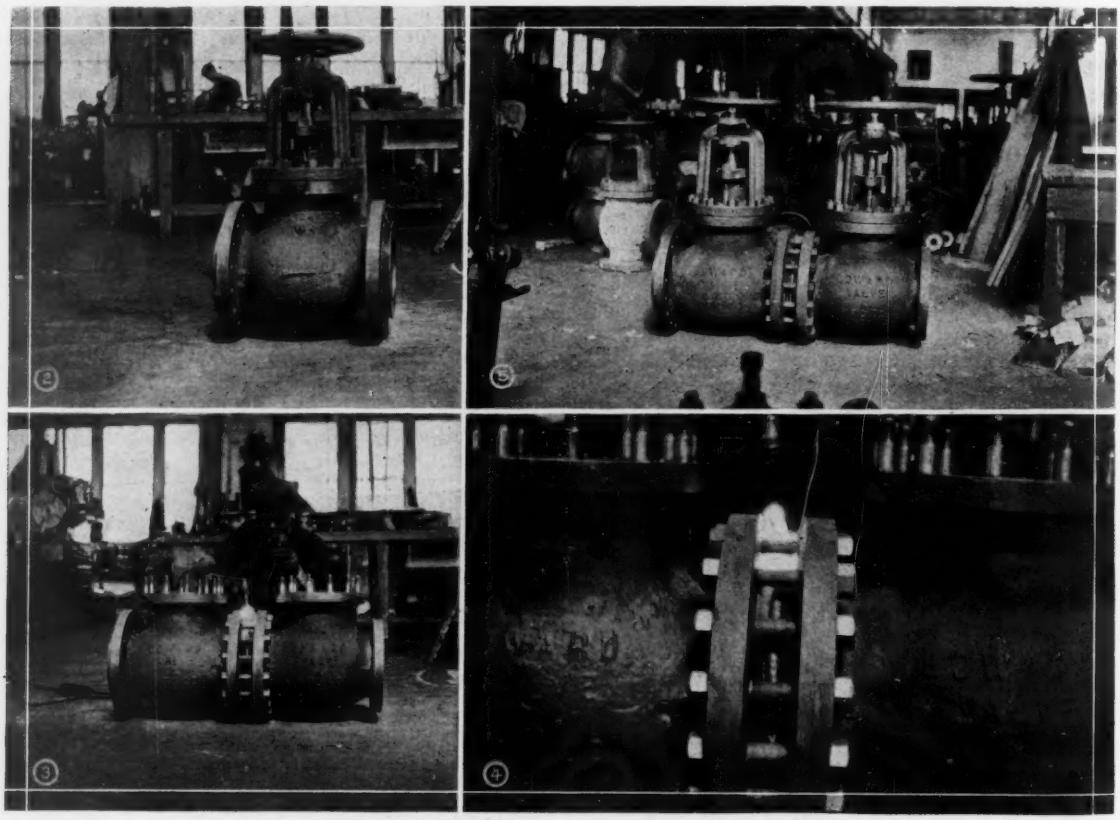


FIG. 1. DETAILS OF NEW PIPE JOINT



FIGS. 2 TO 5. VIEWS SHOWING METHOD OF MAKING NEW JOINT

west Station in connection with a new installation of a 30,000-kw. turbine, in sizes from 7 in. up to 20 in.

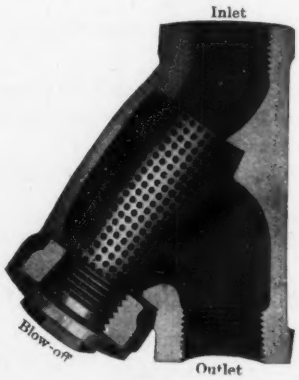
Figure 2 shows the specially prepared flange with the V-notch. Figure 3 shows the process of welding between the 2 valves, one an Edward non-return valve, the other an Edward special valve, 10 such pairs being furnished for the 10 boilers in the new installation. Where possible, the welding is done on the ground, but welding in place is employed for header joints. Figure 4 shows a near view of the welding process, and Fig. 5 the completed operation.

In welding up joints, the flanges are made absolutely clean, and a thin smooth coating of graphite placed on the flange up to within a short distance of the welding rim. The flanges are then drawn together as if the joints were being made permanent. To permit of welding, one bolt at a time is removed, and that spot welded. In moving around the flange, the same procedure is followed, always removing a bolt or two ahead and replacing them after the joint under them is welded. In this way, a solid joint is made, which cannot possibly leak, and yet can be broken apart with comparative ease in case there is necessity of rearranging the piping system. This joint is patented and controlled by the Edward Valve & Mfg. Co., of Chicago.

A Self-Cleaning Strainer

TO protect the vital parts of apparatus, such as pumps, traps, reducing valves and pressure regulators, it is necessary that a strainer should be positive in its action and should be easily cleaned so that it will not impede the flow of the liquid or clog with material which may be washed through.

In the Straight Away Self Cleaning Strainer, made by the Self Cleaning Strainer Co., of Chicago, Ill., a cast-iron body contains a perforated brass strainer cylinder, as shown in the cross-sectional view, the area



STRAIGHT AWAY SELF-CLEANING STRAINER

through the strainer being several times that of the inlet or outlet. This permits very small perforations without in the least checking the flow of steam. By simply opening the blowoff valve, the strainer is cleaned without removing the strainer cylinder from the body of the device.

Construction is such that the strainer may be installed on either horizontal or vertical lines, and that with steam shut off from the line and the blowoff valve opened, the steam line is drained of all condensation, which avoids the possibility of freezing in winter. The strainer is so constructed that it will remove dirt, grit, scale and other foreign substances, and prevent their entering any apparatus which is to be protected. It is useful on either steam or water lines, and is available in sizes from ½ in. to 3 in., the perforations ranging from 1/64 to ⅛ in. diameter. The strainers with 1/64 in. perforations are furnished, unless otherwise specified, for steam, air or gas service, and perforations 3/64 in. for liquid service.

Westinghouse Announcement

ANNOUNCEMENT has been made by the Westinghouse Electric & Manufacturing Co. that the sale of the standard product of the Westinghouse Machine Co. will be handled by the Prime Mover Department of the Electric Co.

E. H. Sniffin, formerly vice-president and sales manager of the Westinghouse Machine Co., has been appointed manager of the Prime Mover Department, and as such will direct the sales of the product of this company, as he has done in the past.

Mr. Sniffin became associated with the Westinghouse Church Kerr & Co. in 1888, first as salesman and afterwards as sales manager. In 1903, when the Machine Co. organized a sales department, Mr. Sniffin was made sales manager. Subsequently in 1905 he was elected vice-president, which position he held at the time of the organization of the Prime Mover Department of the Electric Co.

A Marine Department of the Westinghouse Machine Co. has also been established, with headquarters at East Pittsburgh, which will handle all matters pertaining to the sale of marine refrigeration and main propulsive machinery for vessels and auxiliaries used in connection with this class of apparatus.

All Atlantic seaboard and Great Lakes negotiations for the sale of marine products will be handled by H. M. Southgate, district manager, located in the Bibbs Building, Washington, D. C.

The Pacific coast marine business of this company will be handled by Hunt Mirk & Co., 141 Second St., San Francisco, Cal.

WALTER N. POLAKOV, who has been acting for 2 yr. as Superintendent of Power for the New York, New Haven & Hartford Ry. Co. and who, previously, was with H. L. Gantt and with Day & Zimmermann reorganizing central stations and power plants for efficiency and the introduction of scientific methods of operation, has opened an office for independent consulting practice on management of public utilities, central stations and betterment of power plants at Stamford, Conn. Mr. Polakov's work is well known and has resulted in savings of 30 per cent in cost of producing power for the N. Y., N. H. & H. R. R., and material reduction of costs for the City of New York in its departments of Docks and Ferries, Water Supply, Gas and Electricity. Proof of the satisfaction that he has given is that he will act in consulting capacity for Day & Zimmermann and the Eastern Mfg. Co., by whom he has been retained in past years.

Books and Catalogs

HENDRICKS' COMMERCIAL REGISTER for 1915 has just been issued, being the 24th annual edition. This contains 1487 pages of classified lists of manufacturers and dealers in industrial products, the finding list by classifications covering 147 pages. All classifications are given a number, and the indexing is by classification numbers, which makes the quick finding of any line of product easy. The book has been entirely reset in clean, new type, and has been thoroughly revised, all dead names being eliminated. It forms a convenient commercial register for purchasing agents, and a reliable directory of manufacturers of industrial products. The price is $10, and it is published by S. E. Hendricks Co., 2 W. 13th St., New York City.

BULLETIN NO. 21, just issued by Alberger Pump and Condenser Co., 140 Cedar St., New York, illustrates and describes Alberger centrifugal boiler feed pumps and Alberger-Curtis steam turbines.

THE MAMMOTH vertical file, a piece of office equipment designed by Yawman and Erbe Mfg. Co., Rochester, N. Y., is described in a booklet of interest to machinists and all users of blueprints.

SMALL MOTORS No. 23, issued by the Westinghouse Electric Mfg. Co., describes and illustrates the type CA single-phase motor and its starting mechanism. This motor is made in sizes from 1/20 to ¾ hp.

A CIRCULAR on Rhoads leather belt preserver has just been received from J. E. Rhoads & Sons, Wilmington, Del.

OIL ECONOMIZER CO., Columbus, O., has issued a folder describing its Oil Economizer for use in conjunction with any cylinder oil lubricator now in use.

THE LATEST CIRCULAR from John F. Robertson Co., of Pittsburgh, deals with the R-P steam trap for high pressure, giving price list and dimensions.

Trade Notes

THE EXHIBIT of the Lagonda Mfg. Co. at the Panama-Pacific International Exhibition has been awarded medals of honor on all its products.

THE DIAMOND POWER SPECIALTY CO., Detroit, Mich., manufacturer of mechanical soot blowers, announces the appointment of the Steam Equipment Manufacturing Co. as representatives in Pittsburgh and vicinity. The Steam Equipment Co. is an old established concern, located in the Jenkins Arcade Building; the officers are: B. Houston Hill, president; G. Taylor Swarts, vice president; and John B. Hiles, secretary.

THE CROWN WILLIAMETTE PAPER CO., of Portland, Ore., will shortly increase the capacity of its electric generating station at Oregon City by the installation of a 1250-kw. water-wheel type driven alternating-current generator. This machine will operate in parallel with 2 smaller machines at present installed. The present switchboard equipment will be replaced with a 6-panel board designed to handle both the old and the new generators, together with transformer and feeder equipment.

The new generator and the complete switchboard are being supplied by the Westinghouse Electric & Mfg. Co.

PRACTICAL ENGINEER
Trade-mark, Reg. U. S. Pat. Off.

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Position Wanted

POSITION WANTED—As Meter Foreman and Power Salesman. Have had nine years' practical and technical experience. Thoroughly familiar with the requirements of the Public Service Commission of Pennsylvania. Address Practical Engineer, Box 405, Chicago, Ill. 11-1-1

POSITION WANTED—By man of good habits. Age 30. Technical education. 12 years machinist and electrician. 2 years engineer, 2 years salesman. What have you? Address Practical Engineer, Box 401, Chicago, Ill. 11-1-1

POSITION WANTED—Steam engineer wants position in water works or mill plant; 33 yr. old. Married. Sober. Best of references. Iowa preferred. Address F. J. Kirkpatrick, Indianola, Iowa. 10-15-2

POSITION WANTED—By engineer, 8 yr. experience with steam and electric. Understand gas engines and refrigeration. Temperate, reliable, married man. Member N. A. S. E. Address W. H. Snyder, 53 Brown St., Hartford, Conn. 10-15-2

POSITION WANTED—By engineer with years of experience in ice and electric light plants. Understand both a.c. and d.c. machines. Am a graduate of one of the best colleges in Middle West. A1 references. Ezra D. Dumas, Clarinda, Iowa. 10-15-2

POSITION WANTED—By engineer in medium sized power plant, or large coal mine. Have Illinois license; 7 years' experience with steam engines and boilers. Some experience with electricity. Good habits. References. 24. Illinois preferred. Address W. E. Rohline, Box 224, Farmington, Ill. 10-15-2

POSITION WANTED—By young man with 10 years' practical experience from boiler room up. Hold first-class Massachusetts engineer's license. Will go anywhere. Am total abstainer and can furnish A1 references. Address Practical Engineer, Box 393, Chicago, Ill. 10-15-2

POSITION WANTED—By man 26 years of age. Have had 28 months' experience as general man around stationary power plant, and 2 yrs. running traction engine; also hold fireman's license. Reference will be furnished to any one wishing to correspond with me concerning position. Address Geo. M. Bucey, 1614 O St., Lincoln, Neb. 11-1-1

POSITION WANTED—Stationary Operating Engineer, age 27 years, quick learning and a hustler wants position with a Mechanical or Electrical Engineer or Concern, with chance for advancement. Address Practical Engineer. Box 407, Chicago, Ill. 10-15-1

POSITION WANTED—By an Engineer and Electrician of 10 years' experience. Good machinist, house wiring and motor repair man. Can give good references. Oakley Ray, Alden, Iowa. 11-1-1

POSITION WANTED—Chief Electrician. Young man having had long experience in installing, maintaining and repairing in A.C. and D.C. plants, desires to take charge where improvements in motor operation will be welcomed. Address Practical Engineer, Box 409. Chicago, Ill. 11-1-1

POSITION WANTED—By young man as oiler or fireman in a modern plant. I. C. S. graduate. Address Frank Knapp, 404 S. 5th St., St. Joseph, Mo. 10-15-2

Help Wanted

WANTED—Resident subscription agents in the following cities: Atlanta, Ga.; Cincinnati and Columbus, Ohio; Kansas City, Mo.; Los Angeles, Calif.; Louisville, Ky.; Newark, N. J.; New Orleans, La.; Portland, Ore.; St. Louis, Mo.; San Francisco, Calif.; Washington, D. C. This is an excellent chance for a hustler, who is familiar with power plant conditions, to turn his spare time into dollars. To such a one we offer a Real Opportunity. Write Subscription Departmentt, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf.

FREE ENGINEER BOOKS and power plant tool and specialties for securing new subscribers to Practical Engineer. A dandy chance for the engineer with a little spare time to get some fine premiums. Send for free descriptive circular and terms. Address Practical Engineer, Subscription Department, Chicago, Ill.

Wanted

WANTED—Agents handling boiler specialties in every section to sell for side line a new invented valve for water column and gauge glass, large commission. Address P. J. Creasey, Chelyan. W. Va.

WANTED—Agents handling engine and boiler-room specialties in every section for side line paying large commissions. Give experience, line carried, and territory covered. Address Practical Engineer, Box 381, Chicago, Ill. tf.

WANTED—Agents on commission to sell our Shaking Grates. We will install grates on trial or put in on test at our expense with any grate made. Address Armstrong Mfg. Company, Springfield. Ohio. tf.

A STEAM SPECIALTY SALESMAN with a successful record—and genuine selling ability—can connect himself with one of the oldest and most extensive advertisers in this field. Address Practical Engineer, Box 410, Chicago, Ill. 11-1-1

For Sale

LIGHT PLANT FOR SALE—One 30 KVA. Alternator, 2,300 volts, 60 cycles, revolving field, 3 phase (used less than 3 years). 1 switchboard for same. One 100-HP. Erie City Boiler return tubular with feed water heating system. One 10 x 12 Skinner Engine. All in excellent condition. A real bargain. Harley D. Carpenter, Meadville, Pa. 11-1-1

16 x 30 ALLIS (Reliance type) Corliss engine, heavy duty frame; practically new (cost $2,800); price, $750. 20 x 42 Ohio Corliss engine; heavy duty; perfect condition; $850. Two 350-HP. Sterling watertube boilers, 160 lb. steam pressure, 6 months' service; practically new; $2,600 for both. Two 250-HP. Heine watertube boilers, 150 lb. steam pressure; perfect condition; $2,000 for both, including stack. Duzets & Son, Hudson Terminal Bldg., New York. tf.

Patents and Patent Attorneys

PATENTS THAT PROTECT AND PAY—Advice and books free. Highest references. Best results. Promptness assured. Send sketch or model for search. WATSON E. COLEMAN. Patent Lawyer, 624 F. St., Washington, D. C. tf.

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Bldg., Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had, and the exact costs. Send for full information. tf.

A. P. CONNOR, Consulting Electrical and Mechanical Engineer. Attorney-at-Law and Solicitor of Patents and Trade-Marks. Results guaranteed. 121 Carroll St., S. E., Washington, D. C. tf.-x

PATENTS—Send sketch for free search and reports. Books on patents and book of reference letters sent free. John S. Duffie & Co., 612 F St., Washington, D. C. tf.

PATENTABLE IDEAS WANTED—Send for three free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. tf.

Education and Instruction

ENGINEERS' POCKET MANUAL; 175 pages; gilt edges; bound in leather; edited by University of Tennessee; will be mailed every subscribed sending in one NEW subscription (not your own) to Practical Engineer.

Miscellaneous

ENGINEERS, DO YOU WANT to utilize your exhaust steam for heating or drying purposes, without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill.

Inventions

INVENTIONS commercialized on cash and royalty basis. Inventors and manufacturers should write Adam Fisher Mfg. Co., 2175 Railway Exchange, St. Louis, Mo. tf.

Sparks From The Advertising Pages

Giving Credit Where Credit Is Due

As this issue goes to press the attention of the public is being called to the thirty-sixth anniversary of the invention of the electric incandescent lamp, and Thomas A. Edison, its inventor, is being honored throughout the length and breadth of the land.

Yet as great as is the invention of the incandescent lamp, this anniversary, commemorating it, would be almost unknown were it not for the advertising and publicity accorded to it.

This is viewing the value of cold type and the printing press from an entirely different perspective.

Consider the source of inspiration this publicity is to the budding genius of inventive inclination. Such an inspiration can only contribute to the welfare of humanity, except, of course, when it is employed in the conception of instruments of destruction.

Aside from any pecuniary interest the inventor may have as to the commercial possibilities of his product, he knows at least, that his efforts, if successful, will be properly accredited and that in years to come even though only the first principles of his invention may be in use, or perhaps the whole discarded as impracticable for that age, it will not be recorded as "Believed to have been invented by Mr. So-and-So." Such is the case with the Archimedes Screw which is attributed rather doubtfully to that Greek mathematician,—and many other devices useful in the generations before the printing press.

Even in this dollar-chasing age the thought of proper credit now and in the future has its incentive to the conscientious inventor whose lot at its best is none too bright.

And on this day, October 21st, which has been rightfully named Edison Day, the world-famed inventor is receiving full credit and recognition of his work.

Step by step with the evolution of the incandescent lamp, from the one employing carbonized bamboo to the present Edison Mazda lamp, advertising has played an important part in its development. Edison has said, "Each new invention opens up the way to another," and with many inventions advertising has, in creating wider markets, caused an improvement to be made on the original invention by focusing the attention of the inventive genius who sees room for further development.

This is true of a great many inventions.

It is quite frequently the case however, that as new improvements take place the inventor who has developed the first principles slips into oblivion and it requires publicity to cause this man to be appreciated and to secure the proper credit for the first device which has made all later ones possible.

So let us hold a commercial reverence for advertising because of its educational influence in widening our comforts, increasing our luxuries and developing our necessities.